Nasdaq SPAN®

Margin methodology guide for Commodity derivatives

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Document History

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1 Model purpose and scope

1.1 Purpose and objectives

The purpose of this document is to describe how margins are calculated for commodity derivatives cleared by NASDAQ Clearing AB (Nasdaq Clearing) using the SPAN®1 (Standard Portfolio Analysis of Risk) methodology. The audience for the document is current and new Clearing Members (in this context this expression also includes Clearing Clients) and independent system vendors.

1.2 Scope

The first part of the document describes the basic margin principles and the second part presents examples on margin calculations

2 Introduction

2.1 Margin Requirement

The margin requirement is a fundamental part of central counterparty (CCP) clearing. In case of a clearing members default, it is that member's margin requirement together with the financial resources of the CCP that ensures that all contracts registered for clearing will be honored. Nasdaq Clearing requires margins from all Clearing Members and the Margin Requirement is calculated with the same risk parameters regardless of the Clearing Member's credit rating. The Margin Requirement shall cover the market risk of the positions in the Clearing Member's account. Nasdaq Clearing applies a 99.2% confidence level and assumes a liquidation period of two to five days (depending on the instrument) when determining the risk parameters. The Margin Requirement for participants clearing commodity derivatives consists of the following components: Base Collateral Requirement, Initial Margin, Variation Margin, Option Market Value and Payment Margin. In this document it will be described how these different margin components are calculated.

3 Margin Methodology

3.1 Executive Summary

Nasdaq Clearing uses the SPAN® method to calculate the margin requirement for commodity derivatives. SPAN® calculates the maximum potential loss for a portfolio over a pre-defined close-out horizon by simulating how the portfolio's theoretical value will be affected by various market scenarios. 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?"

3.2 Definitions

Base Collateral Requirement

Should cover overnight risk and must be covered before any clearing can commence.

Contingent Variation Margin

The cost for liquidating a portfolio at the prevailing market prices. It is calculated for Deferred Settlement Future (DSF) contracts in the trading and delivery period and for Futures contracts in the delivery period.

Daily Fix

The closing price of and instrument series, including theoretical Daily Fix during the delivery period, used in margin calculations. See the Clearing Rules (Contract Specification Appendix) for an exact definition.

Deferred Settlement Future (DSF)

Please see the Clearing Rules (Contract Specification Appendix) for a contract definition.

Delivery Margin

A potential cost of financing the market value of cash-flow of an RNP.

Electricity Price Area Differential Future (EPAD)

- Electricity Price Area Differential Deferred Settlement Future
- Electricity Price Area Differential Future

Please see the Clearing Rules (Contract Specification Appendix) for a contract definition.

Expiration Fix

Is the closing price of an instrument series at expiration, used in margin calculations. Please see the Clearing Rules (Clearing Appendix 1 Definitions) for an exact definition.

Initial Margin

Is the maximum potential loss for a portfolio over a pre-defined close-out horizon and is calculated for all contracts in the trading and delivery period.

Inter Commodity Spread Credit

Netting of Initial Margin based on correlation between 'markets' (i.e: Risk Groups).

Margin Calculation Account

Is an account where margin is calculated in a single margin currency, for the aggregate positions of one or several sub-portfolios.

Monthly Deferred Settlement Future (DSF)

Please see the clearing Rules (Contract specification appendix) for a contract.

Naked Initial Margin

Is the initial margin for 'naked' position in the instrument series, without any netting with other series.

Option Market Value

Is based on option price and long (short) option position has a positive (negative) market value.

Payment Margin

(Rulebook: margin component) covers the risk of a buyer not fulfilling Allowance and Elcert settlement obligations and allows for margin credit for a seller that fulfilled Allowance and Elcert delivery; covers pending settlement for Electricity and Natural Gas Monthly DS Futures.

Required Initial Margin

Is the Initial Margin for an instrument series taking into account any netting allowed by the margin model.

Margin Requirement

(Rule book: Daily Margin Requirement) is the expected cost of closing out a Member's positions Margin Requirement = Contingent Variation Margin + Intra-day Variation Margin + Option Market value + Required Initial margin + Payment Margin.

Risk Array

Theoretical value changes in 16 risk scenarios used by SPAN® to determine initial margin.

Risk Interval

The maximum expected price movement of a DSF, Futures or EPAD series during a closeout horizon, in percent of price - or as an absolute value in currency.

Risk Group

Instruments with the same underlying are clustered in a Risk Group, sharing risk parameters.

Risk Neutral Position (RNP)

Is a position where contracts with opposite positions 'neutralize' each other's risk given certain conditions.

Total Margin Requirement

(Rulebook: 'Margin Requirement') is the margin to be covered by the participant and is defined as follows:

Total Margin Requirement = Base Collateral Requirement + Margin Requirement

where;

The Total Margin Requirement is a negative number or zero

The Margin Requirement and the Base Collateral Requirement is a negative number or zero.

Theoretical Daily Fix

Is used in the calculation of margin of instruments in delivery, see Appendix A.

Please see the Clearing Rules (Contract Specification Appendix) for an exact definition.

Time Spread Credit

Netting of Initial Margin based on correlation between two instrument series with the same 'underlying' (Risk Group).

Time Spread Periods

Are defined by the delivery periods of listed instrument series and determined per Risk Group.

Variation Margin

Is the cash-settled Mark-to-market in a Futures trading period. The preliminary mark-to-market is included as a margin component in the intra-day margin calculations.

3.3 Base Collateral Requirement

The Base Collateral Requirement should cover overnight risk and is not a part of the SPAN® margin methodology. When determining the Base Collateral Requirement Nasdaq Clearing takes into account factors such as the participant's internal risk rank, the expected open interest, historic clearing activity and more. Should there be significant changes in i.e. the trading pattern or the risk rank, Nasdaq Clearing will revise the size of the Base Collateral. The Base Collateral Requirement may be offset by the participant's default fund contribution.

3.4 Span Margin Calculation

The SPAN® margin requirement calculation is performed in several steps as outlined below:

1) Market Valuation
    a) Calculate Contingent variation Margin
    b) Calculate Variation Margin
    c) Calculate Option Market value
    d) Perform currency conversion to margin currency
2) Initial Margin
    a) Calculate the risk interval of each instrument series
    b) Calculate the risk array of each instrument series
    c) Calculate Naked Initial Margin of each instrument series in margin currency
    d) Identify Risk Neutral Positions ('RNP')
    e) Calculate Required Initial Margin per Risk Group in margin currency:
        i) Divide instruments into Time Spread periods
        ii) Position Netting within the Time Spread period
        iii) Time Spread Credit within the Risk Group
        iv) Inter commodity Spread Credit between Risk Groups
3) Calculate Payment Margin

3.5 Margin Currency and Currency Conversion of Margin

The Margin Requirement is calculated in a specific Margin Currency. Each Member should define one (1) Margin Currency for a specific Margin Calculation Account, meaning that margin on this account is calculated in the Margin Currency, independent of the instrument currency of the contracts in the portfolio connected to this account. SPAN® applies currency scenarios (high/low) based on current exchange rates and a 'currency Risk Interval', when converting from instrument to margin currency. For currency conversion calculation details, please see Appendix 2 and the margin calculation examples in Appendix 3.

3.6 Market Valuation

Variation Margin and option market value is the cost for liquidating the portfolio at the prevailing market prices. In intra-day calculations the daily Fix is replaced by available intra-day prices. Liquidating the portfolio is to sell bought contracts and buy back the sold contracts.

3.7 Contingent Variation Margin of DSF, EPAD DSF and Monthly DSF

DSF, EPAD DSF and Monthly DSF instruments are 'marked-to-market' every day in the trading period, but the cash settlement is not due until the delivery period. An unrealized gain or loss for DSF series is calculated per trade and accumulated per instrument series.

This unrealized gain or loss is fixed at the contract's expiry date (Expiry Market Settlement) to be paid in instalments in the delivery period. It can also be locked in by closing the position(s). Contingent Variation Margin per DSF trade is calculated during the trading and delivery period for the not yet settled ('remaining') part of the contract, using the following formula:

$$CVM_{DSF,d} = (DF_d - TP) \times Pos_d \times Units_{rem,d+1} \qquad (1)$$

where:

CVM=Contingent Variation Margin

DSF = DSF style contracts

DF= Daily Fix – or theoretical Daily Fix

TP=trade price

Pos=position (of the trade)

$Units_{rem,d}$=remaining number of units (hours, therms) of instrument next Clearing Day

d=calculation day

3.8 Variation Margin of Futures and EPAD Futures

During the trading period Futures and EPAD Futures are subject to a cash-settled markto-market and in intra-day margin calculations, the preliminary settlement amount is included in the required margin as Variation Margin.

During a Futures' and EPAD futures' delivery period, a Contingent Variation Margin is calculated for the not yet settled ('remaining') part of the contract.

$$CVM_d = (TDF_d - FCP) \times Pos_d \times Units_{rem,d+1} \qquad (2)$$

where:

CVM =Contingent Variation Margin

Fut = Futures and EPAD Futures contracts

TDF=theoretical Daily Fix of the instrument series

EF=Expiration Fix of the series

Pos=net position of the instrument series

$Units_{rem}$=remaining number of units (hours, tonnes) of the series, next Clearing Day

d= calculation day

For a Futures and EPAD Futures week contract in the delivery period, the Expiration Fix for the week contract is used as the theoretical fixing price during the entire delivery period. Hence, the Contingent Variation Margin for the Futures week contract in the delivery period is equal to zero (this principle may be altered).

3.9 Option Market Value

The market value of a European Option position is based on the current option Daily Fix. A long (short) Option position has a positive (negative) market value. The Option Market Value is calculated as follows:

$$MV_d = DF_d \times Pos_d \times Units_d \qquad (3)$$

Where:

DF= Daily Fix of the instrument

Pos=net position of the Option

Units= number of units (hours, tonnes) of the Option

d= calculation day

3.10 Initial Margin

The Initial Margin should cover the maximum potential loss of a portfolio at the least favorable price development over a pre-defined close-out horizon and within a confidence interval. The maximum expected price change during the close-out horizon is expressed as a percentage of the price and is referred to as the Risk Interval.

The potential loss is calculated for a set of scenarios where the price change during the close-out horizon varies within the risk interval as well as for two extreme price changes outside the risk interval. For Options, the potential loss is in addition calculated for two levels of volatility parameters. The Naked Initial Margin for a series is the highest potential loss of the scenarios considered.

A certain combination of contracts in a portfolio is allowed to form a Risk Neutral Position which decreases the Initial Margin of the portfolio.

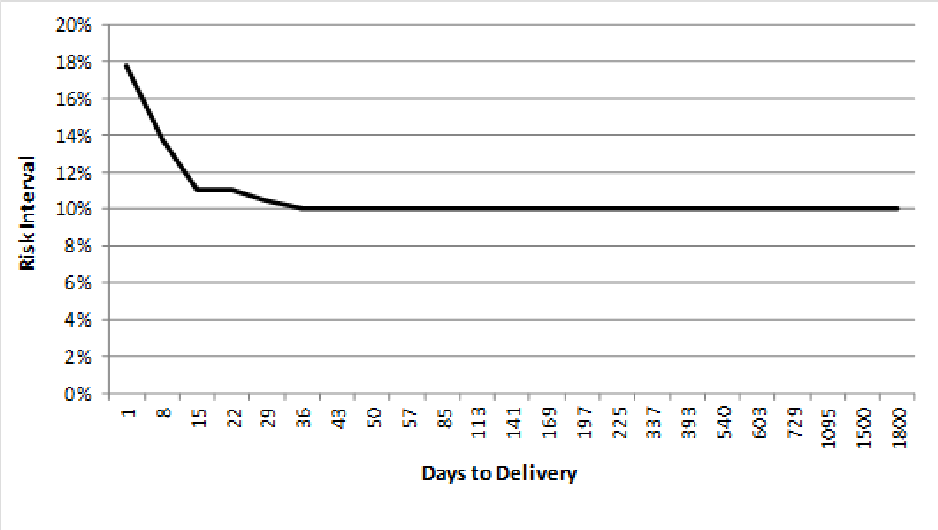
The Initial Margin of a portfolio may be further reduced due to correlation between contract within a market (Time Spread Credit) or across markets (Inter Commodity Spread Credit).

3.11 Calculation of the Risk interval

The Risk Interval is the maximum expected price movement of an instrument series during a certain close-out horizon. A unique Risk Interval is calculated of each margined instrument series on daily basis. Please see Appendix 3 for a detailed calculation example. The Risk Interval is based on historical volatility and time to delivery for an instrument (please see the section 'Estimation of Input

Parameters'). The Risk interval as a function of time to delivery defines the volatility curve as shown in figure 1, and a unique volatility curve may be defined per Risk Group.

Figure 1: Example of volatility curve



The risk interval expressed in instrument currency is calculated as follows:

$$RI_d = DF_d \times RI_{\%d} \quad (4)$$

where:

RI =risk interval of the instrument series, in currency

DF=Daily Fix of the instrument series (intra-day: available intra-day prices)

$RI_{\%}$= risk interval of the instrument series expressed in %

d= calculation day

For Futures contracts where a negative fixing may occur, the actual price used in the Risk Interval in instrument currency (scanning range) calculations is the Daily Fix shifted 'upwards' with a parameter, thereby avoiding to use a negative price in the calculations. In order to handle series where prices are very small, or negative, a curve for the minimum size of the scanning range may be defined as a function of time to delivery. For Electricity Area Price Difference (EPAD) contracts, the Risk Interval in instrument currency is based on the Daily Fix of the 'corresponding Futures or DSF contract' (a contract of the same type and delivery period but with the applicable system price as underlying reference), multiplied with an EPAD risk interval in percent:

$$RI_{EPAD,d} = DF_{F,d} \times RI_{\%EPAD,d} \quad (5)$$

where:

RI =risk interval of the instrument series, in currency

EPAD= Electricity Area Price Difference contract

DF = daily Fix of corresponding Futures contract

RI%= risk interval of the EPAD series expressed in %

F=corresponding Futures or DSF contract

d= calculation day

3.12 Risk Array Calculations

Based on the Risk Interval for the Futures contracts and Implied Volatility scenarios, SPAN® calculates theoretical value changes in 16 different risk scenarios constituting a Risk Array. Only 7 risk scenarios are in practice applicable for Futures or DSF, since 'Implied volatility up/down' is only applicable for Options. The model uses Black 76 to calculate the European option value changes and Turnbull & Wakeman to calculate the value changes for Asian style options. The 'implied volatility scenarios' (up and down) are individually set.

For European Options with delivery-to-strike of DSF contracts, the value from the 'standard' Black-76 model is adjusted with an interest rate factor. This discount factor takes into account that the value of the option at expiry will be paid out over the delivery period of the underlying contract.

The extreme scenarios 15 and 16, with extreme price change of the underlying and unchanged implied volatility, are in practice only applicable for out-of-the money Options contracts (see figure 2).

Theoretical value changes in extreme scenarios (15 and 16) are weighted with a certain factor before initial margin calculation takes place.

Figure 2: SPAN® Risk Scenarios in the Risk Array

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

3.13 Naked Initial Margin

The Naked Initial Margin is the Initial Margin for an outright position in the instrument series, without taking into consideration any delta-netting or correlation with other instruments.

The Risk Array scenario generating the greatest potential loss will be used to calculate the Naked Initial Margin.

The Naked Initial Margin is calculated for each instrument series according to this formula:

$$\mathrm{IM(naked)_d} = \mathrm{Pos_d} \times \mathrm{Units_{rem,d}} \times \mathrm{Round(WRA_d; 2)} \qquad (6)$$

where:

Pos = net position in contract in question

$\mathrm{Units_{rem}}$ = remaining number of units (hours, therms, etc) next *clearing day*

WRA = worst risk array value in currency rounded to two decimals

d=calculation day

3.14 Risk Neutral Positions

A Risk Neutral Position (RNP) is a position where instrument series with opposite positions can “neutralize” each other’s risk given certain conditions. Only Deferred Settlement Futures (DSF) and Futures contracts are allowed to participate in an RNP. An RNP consists of two sides. All instrument series on both sides must belong to the same Risk Group, and must all either be DSF or all be futures. Side 1 should always be the instrument with the longest delivery period, while side 2 should have series with combined delivery periods that exactly match the delivery period on side 1. The number of MW (lots) allowed in an RNP is equal to the lowest absolute position on side 1 or side 2. The position in each series will be reduced with the same amount of MW used in the RNP.

All instruments defined on the same side must have the same sign and the opposite sign compared to the other side. This gives the following allowed combinations:

1. Year contract against quarter contracts covering the same year (delivery period)
2. Quarter contracts against month contracts in the same quarter and year (delivery period).

The synthetic fixing price of a DSFRNP is calculated as a weighted average of the trading prices of the series on side 2.

Market value for a Futures RNP equals the sum of market values of the series on side 1 and market values of the series on side 2.

A DSF RNP has zero Initial Margin. The Contingent Variation Margin is based on the synthetic fixing price of the RNP and the trading price of the series on side 1. The Contingent Variation Margin of a DSF RNP is unchanged as long as an RNP is unchanged.

If Nasdaq Clearing is exposed to a potential cost of financing the upcoming Contingent Variation Margin cash-flow of the DSF RNP, a Delivery Margin will be calculated using the risk free interest rate.

For futures RNP Initial Margin is calculated as a percentage of the sum of naked margin for all participating series.

The total margin requirement for a futures RNP will be market value + Initial Margin.

3.15 Time Spread Periods

The instruments in the portfolio are subdivided into Time Spread Periods before the Required Initial Margin is calculated. These periods are determined per Risk Group, defined by the shortest listed contracts and shall continuously cover the entire forward curve, without gaps.

3.16 Delta Used in Netting

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, a probability weighted delta ('composite delta'), based on delta in the nine price-related Risk Array scenarios, is used in netting.

3.17 Position Netting Whitin a Delivery Period

The first step in the netting calculations is the position-netting within Time Spread Periods ('delta-netting') where a net position is created for each Time Spread Period within a Risk Group, using deltas as described in the section above. Net positions are transferred to the next calculation step.

3.18 Time Spread Credit Due to Correlation

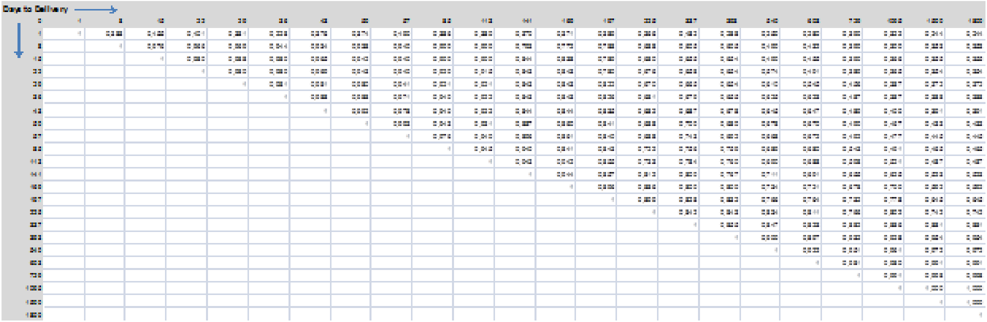
3.18.1 Introduction to Time Spread Credit

The Time Spread Credit determines to what extent the Initial Margin can be reduced due to the correlation between different Time Spread Periods with opposite positions, within the same Risk Group.

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

Figure 3 below shows an example of a correlation matrix which has the same observational points (days to delivery) as the volatility curve.

Figure 3: Example of SPAN® Correlation Matrix



Pairs of Time Spread Periods are sorted according to the most favorable time spread and combined, i.e. the delivery periods with the highest correlation (largest offset) are combined first.

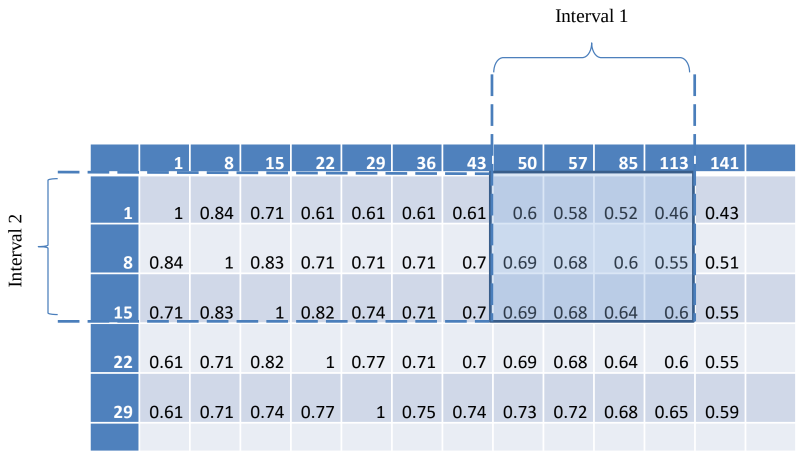
For a pair of combined periods the volume credited is maximized to the energy volume (number of lots*lot size*delta) for the period with the smallest exposure and the delta is calculated as described in the section 'Delta Used in Netting'.

3.18.2 Determining Correlation

The level of correlation will decide which risk scenarios that will be combined to identify the worst-case scenarios for the two Time Spread Periods.

In case the delivery intervals covers more than one bucket in the correlation matrix as it is shown in figure 4, then the minimum correlation from the correlation matrix values covered by the area is chosen.

Figure 4: Determining the Minimum Correlation



	1	8	15	22	29	36	43	50	57	85	113	141	
1	1	0.84	0.71	0.61	0.61	0.61	0.61	0.6	0.58	0.52	0.46	0.43	
8	0.84	1	0.83	0.71	0.71	0.71	0.7	0.69	0.68	0.6	0.55	0.51	
15	0.71	0.83	1	0.82	0.74	0.71	0.7	0.69	0.68	0.64	0.6	0.55	
22	0.61	0.71	0.82	1	0.77	0.71	0.7	0.69	0.68	0.64	0.6	0.55	
29	0.61	0.71	0.74	0.77	1	0.75	0.74	0.73	0.72	0.68	0.65	0.59	

3.18.3 Determining the Worst-Case Scenario

Given the level of price correlation, the risk scenarios allowed to be combined have been defined as the allowed number of 'steps' from the scenario for the first Time Spread Periods, see figure 5. The same risk scenario for both periods (0 steps) gives the largest offset. For 1 step, the same scenario number and the neighboring scenario numbers are combined for the two periods.

Figure 5: Example of number of steps for correlation

Level of price correlation	Number of steps
≥0,95	1
≥0,85	2
≥0,7	3
≥0,5	4
≥0,4	5
≥0,3	6

The scenario for one period will be combined with scenarios for the other period, within a 'window width' defined by the number of steps, to find the worst case scenario, see Fig 6, showing an example with number of steps = 2.

Figure 6: Combining Scenarios with 2 Steps

1st period

Scenario	16	13	9	5	1	3	7	11	15
Price of underlying instrument	Down Extreme	Down 3/3 of SR	Down 2/3 of SR	Down 1/3 of SR	Unchanged	Up 1/3 of SR	Up 2/3 of SR	Up 3/3 of SR	Up Extreme

2nd period

Scenario	16	13	9	5	1	3	7	11	15
Price of underlying instrument	Down Extreme	Down 3/3 of SR	Down 2/3 of SR	Down 1/3 of SR	Unchanged	Up 1/3 of SR	Up 2/3 of SR	Up 3/3 of SR	Up Extreme

The combination of scenarios of the two periods which gives the worst case combined outcome (loss) determines the worst case scenario and initial Margin for the Time Spread Periods in question. For the remaining delivery volume (delta) not affected by the time spread, the naked (or netted within the same time spread period) initial margin will be used.

It should be noted that the search for the worst case scenario is only performed within the same implied volatility scenario and that the worst case scenario for one Time Spread Period may produce a positive Initial Margin number for that period.

3.19 Inter Commodity Spread Credit

3.19.1 Introduction to Inter Commodity Spread Credit

Inter Commodity Spread Credit ('ICSC') is based on correlation between 'markets' (i.e: Risk Groups) and is calculated after all netting possibilities within each Risk Group are utilized.

The ICSC calculations are executed between a combination of delivery periods (tiers) defined by listed instrument series and belonging to different Risk Groups. Each tier has a unique tier number connected to the instrument series.

The volume which is available for ICSC is the remaining volume (delta) after the preceding netting steps and a delta ratio parameter ensures that the scale of price changes for the tiers is the same. The delta ratios thus define proportions in which contracts enter into ICSC.

A correlation based credit parameter determines the credit, equal in % of the initial margin for the tiers in the combination. Tier combinations which have the highest credit factor are netted first.

3.19.2 Current Implementation of ICSC

The credit effect takes place for delivery periods covered by the synthetic month contracts as the smallest contracts. Any ICSC effect on week contracts is determined by considering a week volume as a part of ICSC month contract volume, giving a credit on month contract level and assigning the netting effect on week contract based on the week volume fraction in ICSC.

ICSC may be offered between contracts that are in delivery. In this case, there will be no ICSC a certain number of trading days before the end of the delivery period.

3.19.3 Payment Margin

Payment Margin is calculated for bought Allowance and Electricity Certificate contracts in delivery, to ensure the forthcoming settlement. The margin reflects the settlement amount of a bought (long) Deferred Settlement Future or Futures position, calculated at expiration.

For DSF contracts, the Payment Margin is the sum of the value of the long position (with negative sign) or the short position (with positive sign) based on the Expiration Fix and Contingent Variation Margin on the expiration day.

For Futures, the Payment Margin is the value (with negative sign) of the long position or the value (with positive sign) of the short position based on the Expiration Fix.

Payment Margin is also used to cover pending settlement in markets where trading and settlement calendar occasionally differ. In this case, Payment margin is included into Margin Requirement on trading non-settlement days.

In addition, Payment Margin is applicable for Monthly DSF contracts with a monthly cash settlement that is based on accumulated daily settlement calculations. Monthly DSF contracts Payment margin covering weekend or holiday settlement is calculated in the first intraday margin run on Monday (first trading day after holiday).

This margin component reflects netted postponed settlement per position (for instruments in question) in instrument currency. If instrument currency is different from risk (margin) currency, currency conversion rules specified in Appendix 2 are applied.

3.19.4 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 all listed contracts is produced and distributed in the evening of a trading day. The file includes data referring to the last trading day for each of the markets.

3.19.5 SPAN® Risk Parameter Changes

The SPAN® risk parameters are continuously evaluated and revised by the Clearinghouse. According to the Clearing Rules, all parameters may be changed within short notice. The input parameter estimation process is described I the next section.

4 Estimation of Input Parameters

4.1 General Parameters

4.1.1 Introduction

The following general parameters are a group of parameters, which defines the general properties of margin model:

- Confidence interval
- Liquidation period and;
- Look-back period

In the below text we will briefly discuss the above parameters, including the estimation of the following key risk parameters:

- Volatility Curves
- Time Spread Credit correlation and;
- Inter Commodity Spread Credits

4.1.1.1 Confidence Interval

The confidence interval is the percentage of the exposure movements for each cleared financial instrument that is required to be covered by the margin with respect to the individual Look-back and Liquidation period.

The confidence interval is set to:

- 99,2% for exchange traded products;
- 99.5% for OTC traded products.

4.1.1.2 Liquidation Period

The liquidation period represents the time interval needed to liquidate the Clearinghouse's exposure in a default situation.

Example:

In the commodities markets the liquidation period is currently set to minimum two days taking into account the following (this can be subject to changes):

- For margin model purposes the longest time period between margin call and margin collection is estimated to one (trading) day.
- The interval for analysis of the structure of defaulted portfolios, issue of request for quotes based on close-out agreements is estimated to one (trading) day.
- The interval for Clearinghouse decision on the close-out quotes is estimated to one day for liquid markets and two days for less liquid markets.

- The interval for finalization of close-out, meaning that after this period all positions on all accounts are fully covered by collateral provided by non-defaulted members, is estimated to one (trading) day.

4.1.1.3 Look-back Period

The look-back period defines the historical time horizon used by the Clearinghouse for parameter estimation.

The look-back period for the commodities markets is set to:

- One year for estimation of volatility curves and correlation matrices;
- Five years for estimation of Inter Commodity Spread Credits.

The length of a look-back period cannot be less than one year, to discover possible seasonal effects.

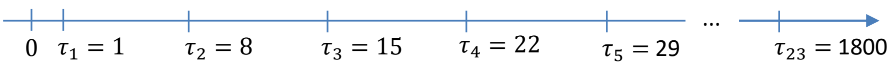
4.1.1.4 Volatility Curve Estimation

The estimation procedure for volatility curves is done at the moment T^* over a look-back period L for a liquidation period of n days and the volatility curve is the basis for the Risk Interval of a Risk Group.

Volatility Time Grid

The volatility is represented by a stair function with constant values for each interval of a time grid. The time grid is configured in accordance to the product properties and takes into account the shortest and longest time to delivery for the contracts listed. It also indirectly reflects volatility behavior for close to delivery contracts, being finer at short to delivery times. An example of subdivision of a time line into the time grid is presented below.

Figure 7: Volatility Time Grid



The intervals are denoted by the beginning time point in the interval and include the smallest time point in the interval and the last time interval continues up to infinity, which is not included.

Volatility Look-back and Liquidation period

The volatility curve is estimated based on the historical information about Futures prices over a specified look-back period. The data sample consists of the observed Futures' relative price changes over the look-back period and takes into account the number of lead days.

Volatility Curve Buckets

For each date, the observations from the sample are distributed in 'buckets', which are defined by the intervals of the time grid.

The volatility for a bucket, for a given confidence interval, is estimated by approximation of the distribution tail for the time series, using the Generalized Pareto distribution, and the volatility curve of a Risk Group is based on the volatility of the time buckets.

4.1.1.5 Time Spread Correlation Estimation

Correlation Time Grid and Buckets

For estimation of correlation table for a Risk Group the same time grid, buckets and observations sample are used as for the volatility curve. The correlation coefficient between two time intervals shows observed correlation between contracts, which have their delivery intervals overlapping the time intervals.

For a given pair of intervals and each date within the look-back period the observations are presented within the buckets of the time grid and represent all observed relative price changes of the bucket.

Time Spread Correlation Matrix

The correlation matrix of a Risk Group includes the estimated correlation coefficients between the time intervals of the time grid. A correlation coefficient between two time intervals is estimated based on two time series with observations in the two buckets.

The number of steps used when combining scenarios is based on the statistically tested relationship between the correlation value and number of steps. The analysis is made with use of the same techniques as for the estimation of ICSC (next section).

4.1.1.6 Inter Commodity Spread Estimation

The Inter- Commodity Spread parameters per pair of tier numbers are 'contract delta-spread ratio' and the amount of credit in percent of initial margin. The parameters are estimated over a look-back period.

Delta-spread Ratio

For a given pair of tiers the delta values of the respective tier are chosen proportional to the average Risk Interval of the opposite contract over last month before the estimation date. The main goal for the deltas is to keep average price change ranges the on the same level for both sides of the spread.

Credit Percentage Estimation

The estimation of the Credit percentage is based on the 'profit and loss ratio' between absolute value of the actual net price change, considering deltas and direction of the tiers, and the sum of naked initial margin.

The distribution of the above ratio is approximated by the Generalized Pareto distribution.

Appendix A - Theoretical Daily Fix

A.1 Introduction

If a contract in delivery is not traded, a theoretical Daily Fix is calculated to be used in the margin calculations.

The calculation of theoretical Daily Fix for the following contract types is described below:

- Futures, EPAD and Monthly DSF Block, Day, Week, Working Week, Weekend
- DSF and Futures Month, Monthly DSF Month, Quarter, Season and Year EPAD Month

A.2 Theoretical Daily Fix for Futures, EPAD and Monthly DSF Block, Day, Week, Working Week, Weekend

For a Future, EPAD and Monthly DSF block, day, week, working week and weekend contract in the delivery period, the Expiry Fix of the actual contract is used as the theoretical Daily Fix during the entire delivery period.

A.3 Theoretical Daily Fix for DSF and Futures Month, Monthly DSF Month, Quarter, Season and Year

The theoretical Daily Fix of a month, quarter, season and year Futures, DSF and Monthly DSF is equal to the weighted Daily Fixes of shorter contracts overlapping the remaining delivery period of the contract in question, including any overlapping shorter contract in delivery. Figure 7 illustrates shorter overlapping contracts that contribute to the calculation of the theoretical Daily Fix for any contract in question.

Figure 7: Overlapping contracts in the calculation of theoretical Daily Fixes of a month, quarter, season and year contracts

Type of the contract	Shorter overlapping contracts	
	Electricity	**Natural Gas**
Month	Week	Working day week, Weekend
Quarter	Month	Month
Season	N/A	Quarter
Year	Quarter	Quarter

The number of units (hours, megawatt hours or therms) used as weights in the calculation of the theoretical Daily Fix is the units left of the delivery period at the end of the actual trading day. The theoretical Daily Fix from the preceding trading day is used in intra-day calculations and the end-of-day margin calculation on a bank holiday.

Example:

Standing on a Monday, the calculation includes series and units covering Tuesday and all delivery days until and including the last day of the month.

Standing on a Friday, instrument series and units covering Saturday and Sunday and further out are included.

To calculate the theoretical Fix for ENOMOCT-13 for Monday 14 October 2013 (week 42) the following overlapping instrument series and hours should be used:

- ENOW42-13 (144 hours overlapping, excluding Monday 14 Oct)
- ENOW43-13 (169 hours overlapping)
- ENOW44-13 (96 hours overlapping)

The theoretical Daily Fix for a month Futures contract is calculated using this formula:

$$\mathrm{TDF_{Fut,d}} = \frac{1}{\mathrm{Units_{rem,d+1}}} \sum_{\mathrm{d=m}}^{\mathrm{n}} (\mathrm{DF_d} \times \mathrm{Units_{rem,d+1}}) \qquad (7)$$

where:

TDF_{Fut}= theoretical Daily Fix of Futures month

DF=Daily Fix for contracts overlapping the month in delivery

$Units_{rem}$=number of units remaining, month Futures in delivery and overlapping Futures

m=first overlapping Futures contract

n=last overlapping Futures contract

d=calculation day

A.4 Theoretical Daily Fix for EPAD Month

For EPAD month contracts, the theoretical Daily Fix is calculated according to the following formula:

$$\mathrm{TCP_{EPAD,d}} = \frac{\frac{1}{\mathrm{n}}\sum_{\mathrm{d=1}}^{\mathrm{n}} \mathrm{Dif_d}}{2} + \frac{\mathrm{DF_d}}{2} \qquad (8)$$

where:

TDF_{EPAD}= theoretical Daily Fix of EPAD month

Dif=the difference between the relevant spot reference prices

n=number of quoting days for the spot reference price included in the calculation basis

DF = Daily Fix day d for the relevant EPAD with delivery next month

d=calculation day

For month Futures in the delivery period, the Daily Fix is calculated using a combination of observed underlying prices month-to-date and the Daily Fix for the nearest tradable month Futures contract.

Appendix B - **Currency Conversion**

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

B.1 Currency Conversion and Initial Margin

When converting from instrument to risk (margin) currency SPAN® applies currency scenarios (high/low) based on current exchange rates and a 'currency Risk Interval'.

The Risk Interval used in the Initial Margin calculations is converted into an interval in margin currency, for an instrument series denominated in a currency different from the margin currency,

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 'Calculating Risk Arrays':

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, and the result is rounded to 2 decimals. 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

B.2 Currency Conversion and Variation Margin

For Contingent Variation Margin and intra-day Variation Margin components, the 'high' ('low') scenario is used when converting a negative (positive) number to the margin currency. The Variation Margin is converted per position in the contract series. The above also applies for the Option Market Value.

Appendix C - ELECTRICITY MARKETS

This appendix illustrates a margining of Electricity derivatives instrument series cleared at Nasdaq Clearing. An overview of existing Electricity markets is available below in Table 1:

Table 1: *Electricity markets cleared at Nasdaq Clearing*

Geographical area	Product	Instrument series length	Instrument currency
Nordic	Futures, DSF, option, EPAD Futures, EPAD DSF	Day, week, month, quarter, year	EUR
German	Futures, DSF, Option, EPAD Futures	Day, week, month, quarter, year	EUR
	Monthly DSF	Block, day, weekend, working day week, week, month, quarter, year	EUR
Netherlands	Futures	Week, month, quarter, year	EUR
	Monthly DSF	Day, weekend, working day week, week, month, quarter, year	EUR
UK	Futures	Week, month, quarter, season	GBP
	Monthly DSF	Block, day, weekend, working day week, week, month, quarter, year	GBP
France	Futures	Day, week, month, quarter, year	EUR
	Monthly DSF	Block, day, weekend, working day week, week, month, quarter, year	EUR
Belgium	Monthly DSF	Day, weekend, working day week, week, month, quarter, year	EUR
Italy	Monthly DSF	Day, weekend, working day week, week, month, quarter, year	EUR
Spain	Monthly DSF	Day, weekend, working day week, week, month, quarter, year	EUR

C.1 Conting Variation Margin calculation

The Contingent Variation Margin is calculated for Electricity Deferred Settlement Future (DSF) and Electricity Price Area Differential Deferred Settlement Future (EPAD DSF) in the trading and delivery period and for Electricity Futures in the delivery period. The Market Value is calculated for the option instrument series until it is exercised. The Contingent Variation Margin for Electricity Futures in the trading period is equal to 0 in the end-of-day Margin Requirement calculation. Electricity Futures Variation Margin is present in the intra-day Margin Requirement calculations to reflect the risk of mark-to-market settlement (see section “Market Valuation”).

Example: Calculation of Contingent Variation Margin in the trading period

Product	Deferred settlement future
Instrument series	ENOYR-15
Position	+5 MW
Hours	8760 H
Trade price	€55/MWh
Daily Fix	€50/MWh
# of trades	1
Margin currency	EUR

The Contingent Variation Margin for the DSF ENOYR-15 is calculated using Formula:

$$\mathrm{CVM(ENOYR-15)} = (€\ 50/\mathrm{MWH} - €55/\mathrm{MWH}) \times 5\ \mathrm{MW} \times 8760\ \mathrm{H} = -€219\ 000$$

Example: Calculation of Option Market Value in the trading period

Product	Option on deferred settlement future
Instrument series	EDEBLCQ43SEP3-45
Position	-10 MW
Hours	2209 H
Trade price	€2/MWh
Daily Fix	€3/MWh
# of trades	1
Margin currency	EUR

The market value for the Option instrument series in question is obtained by using Formula:

$$\mathrm{MV(EDEBLCQ43SEP3-45)} = €\ 3/\mathrm{MWH} \times\ -10\ \mathrm{MW} \times 2209\ \mathrm{H} = € - 66\ 270$$

Example: Calculation of Contingent Variation Margin in the delivery period

Product	EPAD DSF
Instrument series	SYTALNOV-13
Position	-1 MW
Hours	456 H
Trade price	€2/MWh
# of trades	1
Margin currency	EUR

In order to calculate a Contingent Variation Margin for the EPAD, a theoretical Daily Fix has to be estimated. The theoretical Daily Fix is obtained by using Formula:

***Table 2:** Calculation of theoretical Daily Fix for EPAD DSF*

Business date	SYS	Talinn	Difference	Daily Fix SYTALDEC-13	Theoretical Fix SYTALNOV-13
11.11.2013	43,27	43,45	0,18	-0,8	-0,96

10.11.2013	44,44	43,59	-0,85
09.11.2013	44,33	43,09	-1,24
08.11.2013	43,83	42,79	-1,04
07.11.2013	42,9	40,22	-2,68
06.11.2013	39,97	39,37	-0,6
05.11.2013	39,85	39,58	-0,27
04.11.2013	39,18	38,56	-0,62
03.11.2013	39,93	38,84	-1,09
02.11.2013	40,94	39,11	-1,83
01.11.2013	40,16	39,17	-0,99
31.10.2013	41,05	39,88	-1,17
30.10.2013	35,66	35,65	-0,01
29.10.2013	38,14	38,06	-0,08
28.10.2013	39,67	39,09	-0,58
27.10.2013	39,41	38,96	-0,45
26.10.2013	40,02	39,54	-0,48
25.10.2013	38,8	39,13	0,33
24.10.2013	38,25	37,93	-0,32
23.10.2013	36,12	36,1	-0,02
22.10.2013	37,4	37,41	0,01
21.10.2013	40,98	39,59	-1,39
20.10.2013	39,59	38,81	-0,78
19.10.2013	36,36	36,28	-0,08
18.10.2013	34,06	34,23	0,17
17.10.2013	38,6	35,99	-2,61
16.10.2013	35,21	34,6	-0,61

Inserting Daily Fix and other variables into Formula 2, the Contingent Variation Margin for SYTALNOV-13 is calculated:

$$\text{CVM(SYTALNOV} - 13) = (€ - 0{,}96/\text{MWH} - €2/\text{MWH}) \times -1\text{ MW} \times 456\text{ H} = €1348$$

Example: Calculation of Contingent Variation Margin in the delivery period with currency conversion

Product	Futures
Instrument series	EUKBLMOCT-13
Position	+15 MW
Hours	408 H
Expiration fix	£50/MWh
# of trades	1
EURGBP	1,123456
Margin currency	EUR

A starting point in the calculation of Contingent Variation Margin in the delivery period is the estimation of the theoretical Daily Fix. For this purpose the Daily Fixes of underlying instrument series are obtained. For the instrument series in question, the following underlying instrument series and fixes are available:

Table 3: *Overview of underlying instrument series and fixes*

Instrument series	Hours left	Daily Fix
EUKBLW42-13	144 H	£50/MWh
EUKBLW43-13	168 H	£45/MWh
EUKBLW44-13	96 H	£47/MWh

The theoretical Daily Fix is calculated as follows ,see Formula:

$$\text{TDP}(\text{EUKBLMOCT} - 13) = \frac{£50/\text{MWH} \times 144\text{H} + £45/\text{MWH} \times 168\text{H} + £47/\text{MWH} \times 96\text{H}}{408\text{H}} = £47{,}23/\text{MWH}$$

Having estimated a theoretical Daily Fix, the Contingent Variation Margin for the future EUKLBLMOCT-13 is obtained using Formula:

$$\text{CVM}(\text{EUKBLMOCT} - 13) = (£47{,}23/\text{MWH} - £50/\text{MWH}) \times 15\ \text{MW} \times 409\ \text{H} \times \text{EURGBP}\ 1{,}123456 = € - 19023$$

4.2 Initial Margin calculation

The Initial Margin is calculated for an Electricity Futures, DSF, Option, EPAD Futures and EPAD DSF in both trading and delivery period. The Initial Margin is a part of both intra-day and end-of-day margin requirement. If the Margin Currency is different from the Instrument Currency, the Initial Margin is converted at the applicable exchange rate.

The examples below illustrate step by step calculation of Initial Margin.

4.2.1 Estimating Risk Interval in % and currency

Example: Calculation of Risk Interval in % and currency (scanning range)

Product	Future
Instrument series	ENLBLW47-13
Delivery period	18-24.11.2013
Days to start of delivery	19 d
Days to stop of delivery	25 d
Daily Fix	€55

In order estimate a Risk Interval for the delivery period in question, the principles described in section “Calculation of the Risk Interval” shall be applied. A starting point is to obtain a volatility table for the market in question:

Table 4: *Example of volatility table for Dutch Electricity market*

Days to start and stop of delivery	Risk Interval
1	43,00%
8	40,00%
15	35,00%
22	25,00%
29	22,00%
36	20,00%
43	17,00%

The Risk Interval for a delivery period where the middle of the delivery period is between two observations is calculated as follows: for a delivery period with 19 days to start of delivery and delivery ending at day 25, SPAN® has the following approach: 3/7 of the period derives from the "15 days to delivery" observations and 4/7 from "22 days to delivery". This results in the following Risk Interval in %:

$$\mathrm{RI}(\mathrm{ENLBLW47}-13)=\frac{3}{7}\times 35{,}00\%+\frac{4}{7}\times 25{,}00\%=15{,}00\%+14{,}29\%=29{,}29\%$$

Risk Interval in the instrument series currency is:

$$\mathrm{RI}(\mathrm{ENLBLW47}-13)=29{,}29\%\times €55=€16{,}11$$

Example: Calculation of Risk Interval in % and currency (scanning range)

Product	EPAD Futures
Instrument series	EDEFRFUTBLQ2-16
Corresponding instrument series	EDEFUTBLQ2-16
Daily Fix of corresponding instrument series	€ 40
Delivery Period	01.04-30.06.2016
Risk Interval of EPAD	15%

The Risk Interval of an EPAD Futures is calculated based on the price of the corresponding Future or DSF and a volatility table defined for the EPAD Risk Group. Using Formula 5, the Risk Interval for the EPAD Futures in question expressed in the instrument currency is:

$$\mathrm{RI}(\mathrm{EDEFRFUTBLQ2}-16)=15\%\times €40=€6$$

4.2.2 Calculating the Risk Array

Example: Risk Array calculation

Product	Deferred Settlement Futures
Instrument series	ENOYR-14
Delivery period	01.01-31.12.2014
Scanning range	€3,47
Daily Fix	€43,1

As described in the section “Risk Array Calculation”, the next step in the calculation of Initial Margin is the estimation of risk scenarios. Based on the data above, the following risk scenarios are available for ENOYR-14:

Table 5: *Example of Risk Array calculation for DSF*

Scenario	Theoretical price scenario	Implied volatility	Theoretical value change ENOYR-14
1	43,1	-	0
2		-	
3	44,26	-	1,16
4		-	
5	41,94	-	-1,16
6		-	
7	45,41	-	2,31
8		-	
9	40,79	-	-2,31
10		-	
11	46,57	-	3,47
12		-	
13	39,63	-	-3,47
14		-	
15	53,51	-	3,12*
16	32,69	-	-3,12*

*theoretical value changes in extreme scenarios are weighted with a factor 0,3 (+/-10,41 x0,3)

Example: Risk array calculation

Product	Option
Instrument series	EDEBLCYR7DEC6-49
Underlying instrument series	EDEBLYR-17
Delivery period of underlying DSF	01.01-31.12.2017
Scanning range	€3,47
Daily Fix for underlying DSF	€43,1
Implied volatility	28%

In the estimation of a Risk Array for option instrument series, the implied volatility shall be considered. Theoretical values and value changes are calculated for seven different prices of the underlying derivative implemented under two volatility levels (up and down) and two extreme price scenarios of the underlying derivative that exceed the scanning range (volatility unchanged). Inserting the available variables into Black-76 model (see section "Risk Array Calculations"), the following risk scenarios are obtained for the instrument series in question:

Table 6: *Example of Risk Array calculation for Option*

Scenario	Theoretical price scenario for underlying DSF	Implied volatility (+20%, -12%)	Theoretical value EDEBLCYR7DEC6-49	Theoretical value change EDEBLCYR7DEC6-49
1	43,1	0,336	3,69	0,93
2		0,2464	2,21	-0,55
3	44,26	0,336	4,17	1,41
4		0,2464	2,62	-0,14
5	41,94	0,336	3,24	0,48
6		0,2464	1,84	-0,92
7	45,41	0,336	4,68	1,92
8		0,2464	3,07	0,31
9	40,79	0,336	2,82	0,06
10		0,2464	1,52	-1,24
11	46,57	0,336	5,23	2,47
12		0,2464	3,57	0,81
13	39,63	0,336	2,44	-0,32
14		0,2464	1,23	-1,53
15	53,51	0,28	4,34	1,58*
16	32,69	0,28	2,06	-0,70*

*theoretical value changes in extreme scenarios are weighted with a factor 0,3 (5,27 x0,3 in scenario 15 and -2,34x0,3 in scenario 16)

4.2.3 Calculating Naked Initial Margin

After scanning range and risk scenarios are estimated, the scenario generating the greatest potential loss shall be chosen to calculate a Naked Initial Margin. If instrument series currency is different from margin currency, the Naked Initial Margin in converted using the applicable exchange rate.

Example: Naked Initial Margin calculation in the trading period

Product	Deferred settlement future
Instrument series	ENOYR-14
Delivery period	01.01-31.12.2014
Position	+1 MW
Hours	8760 H
Risk array	See table 4

For the instrument series in question, the worst case scenario will be scenario 13 – a price decrease by 3/3 of the scanning range. Applying Formula 6, the Naked Initial Margin for the DSF ENOYR-14 is:

$$IM_{naked}(ENOYR-14) = 1\ MW \times 8760\ H \times € - 3{,}47 = € -\ 30\ 397$$

Example: Naked Initial Margin calculation in the trading period

Product	Option
Instrument series	EDEBLCYR7DEC6-49
Underlying instrument series	EDEBLYR-17
Delivery period of underlying DSF	01.01-31.12.2017
Position	-5 MW
Scanning range for underlying DSF	€3,47
Daily Fix for underlying DSF	€43,1
Implied volatility	28%
Risk array	See Table 6

As it is seen from the Table 6, the greatest loss for this instrument series is in scenario 11 – a price increase by 3/3 of the scanning range for the underlying DSF and an increase in the implied volatility level by 20%. Applying Formula 6, the Naked Initial Margin for this option instrument series will be:

$$\mathrm{IM_{naked}}(\mathrm{EDEBLCYR7DEC6} - 49) = -5\ \mathrm{MW} \times 8760\ \mathrm{H} \times €2{,}47 = € -\ 108\ 186$$

Example: Naked Initial Margin calculation in the trading period

Product	EPAD Futures
Instrument series	EDECZFUTBLMNOV-13
Position	-5 MW
Hours	720
Corresponding instrument series	EDEFUTBLMNOV-13
Daily Fix of corresponding instrument series	€ 40
Delivery Period	01-30.11.2013
Risk Interval of EPAD	10%

In order to calculate the Naked Initial Margin for the Electricity Price Area Differential Future, the worst scenario in the risk array for this instrument series has to be identified.

The Risk Interval of an EPAD Futures is calculated based on the price of the corresponding Future or DSF and a volatility table defined for the EPAD Risk Group. Using Formula 5, the Risk Interval for the EPAD Futures in question expressed in the instrument currency is:

$$\mathrm{RI}(\mathrm{EDECZFUTBLMNOV} - 13) = 10\% \times €40 = €4$$

For the instrument series in question, the following risk array was estimated:

Table 7: *Example of risk array calculation for EPAD Futures*

Scenario	Theoretical value change EDECZFUTBLMNOV-13
1	0
2	
3	1,3
4	

5	-1,3
6	
7	2,7
8	
9	-2,7
10	
11	4,0
12	
13	-4,0
14	
15	3,6*
16	-3,6*

*theoretical value changes in extreme scenarios are weighted with a factor 0,3

The worst case scenario for the delivery period in question is scenario 11 (price increase of 3/3 of scanning range). The Naked Initial Margin is:

$$\mathrm{IM}_{\mathrm{naked}}(\mathrm{EDECZFUTBLMNOV}-13) = -5\ \mathrm{MW} \times 720\ \mathrm{H} \times €4 = €-\ 14\ 400$$

Example: Naked Initial Margin calculation in delivery with currency conversion

Product	Future
Instrument series	EUKBLMOCT-13
Position	+15 MW
Hours	408 H
Worst risk array value	£-5,35
EURGBP (incl. hair-cut)	1,123456
Margin currency	EUR

The Naked Initial Margin calculation in the delivery period is performed in the same way as in the trading period. When a currency conversion takes place, the worst risk array value is multiplied with the exchange rate (including applicable hair-cut) between the instrument series currency and margin currency and rounded to two decimals afterwards (see Appendix 2 “Currency Conversion”). The converted Naked Initial Margin for the Future instrument series EUKBLMOCT-13 is:

$$IM_{naked}(EUKBLMOCT-13) = 15\ MW \times 408\ H \times Round(£-5{,}35 \times EURGBP\ 1{,}123456; 2) = €-\ 36\ 781$$

4.2.4 Identifying Risk Neutral Positions

The first step in the calculation of Initial Margin for portfolio is to identify Risk Neutral Positions. Only DSF and Futures can participate in creating an RNP. All contracts in an RNP must be either DSF or Futures, i.e. it is not possible to create an RNP with a mixture of the two. An RNP position will have a zero Initial Margin. The Contingent Variation Margin of RNP position will be based on the synthetic fix as a weighted average of the underlying instrument series’ Daily Fix.

Example: Calculation of DSF RNP

Table 8: *Initial portfolio of DSF*

Instrument series	Position, MW	Hours, H	Daily Fix, €/MWh	CVM, €

EDEBLQ1-14	1	2159	41,6	-94 996
EDEBLQ2-14	2	2184	34,41	-32 170
EDEBLQ3-14	1	2208	33,5	221
EDEBLQ4-14	3	2209	41,63	-30 176
EDEBLYR-14	-5	8760	37,7	1 249 176
Sum				**1 092 056**

Following the logic described in the section "Risk Neutral Positions", the following sides are created for the portfolio in question:

Table 9: *RNP Sides for DSF portfolio*

Side 1		Side 2	
Instrument series	**Position, MW**	**Instrument series**	**Position, MW**
EDEBLYR-14	-1	EDEBLQ1-14	1
		EDEBLQ2-14	1
		EDEBLQ3-14	1
		EDEBLQ4-14	1

As it is seen from the Table 9, an RNP position of 1 MW can be created. The positions of instrument series participating in the RNP are reduced with the RNP position. After the RNP position is created, the portfolio will look as follows:

Table 10: *RNP adjusted portfolio of DSF*

Instrument series	Position, MW	Hours, H
EDEBLQ1-14	0 MW	2159
EDEBLQ2-14	1 MW	2184
EDEBLQ3-14	0 MW	2208
EDEBLQ4-14	2 MW	2209
EDEBLYR-14	-4 MW	8760
RNPEDEBLYR-14	**1 MW**	**8760**

As stated previously, the RNP position has 0 in Initial Margin[1]. The Contingent Variation Margin of the RNP position is calculated using a synthetic fix (a weighted average of Daily Fixes on instrument series on side 2). The synthetic fix for EDEBLYR-14 is calculated as follows:

$$\mathrm{SF(EDEBLYR-14)} = \frac{€41{,}6/\mathrm{MWH} \times 2159\mathrm{H} + €34{,}41/\mathrm{MWH} \times 2184\mathrm{H} + €33{,}5/\mathrm{MWH} \times 2208\mathrm{H} + €41{,}63/\mathrm{MWH} \times 2209\mathrm{H}}{8760\mathrm{H}}$$
$$= \mathbf{€37,77/MWH}$$

1 If there is an exposure to a potential cost of financing the market value of cash-flow of the risk neutral position, a financing margin will be calculated. This financing margin will be reflected in the Naked Initial Margin column in the clearing reports.

For the purpose of calculating the Contingent Variation Margin, the instrument series on side 1 is split into the instrument series on side 2. The Contingent Variation Margin for the original position is subdivided between quarters:

Table 11: *Split of the DSF year into quarters*

	Position, MW	Hours, H	Volume, MWH	CVM, €
EDEBLYR-14	-5	2159	-10795	307873
EDEBLQ1-14	1	2159	2159	-94996
Net Q1				**212878**
EDEBLYR-14	-5	2184	-10920	311438
EDEBLQ2-14	2	2184	4368	-32170
Net Q2				**279268**
EDEBLYR-14	-5	2208	-11040	314861
EDEBLQ3-14	1	2208	2208	221
Net Q3				**315082**
EDEBLYR-14	-5	2209	-11045	315003
EDEBLQ4-14	3	2209	6627	-30176
Net Q4				**284828**
Sum net				**1092056**

The Contingent Variation Margin per quarter for EDEBLYR-14 (original position) is obtained in the following way (using data in Table 6 and Q1 as an example):

$$\mathrm{CVM}(\mathrm{EDEBLYR}-14)_{\mathrm{Q1}} = \frac{€1\,249\,176}{8760\mathrm{H}} \times 2159\mathrm{H} = €307\,873$$

As a next step, the Contingent Variation Margin is calculated per RNP position:

Table 12: *Calculation of CVM for the RNP position*

	Position, MW	Hours, H	Volume, MWH	CVM, €
EDEBLYR-14	-1	2159	-2159	61416
EDEBLQ1-14	1	2159	2159	-94996
Net Q1				**-33579**
EDEBLYR-14	-1	2184	-2184	62127
EDEBLQ2-14	1	2184	2184	-16085
Net Q2				**46042**
EDEBLYR-14	-1	2208	-2208	62810

EDEBLQ3-14	1	2208	2208	221
Net Q3				**63031**
EDEBLYR-14	-1	2209	-2209	62839
EDEBLQ4-14	1	2209	2209	-10059
Net Q4				**52780**
Sum net				**128275**

Using data in Table 9 and Q1 as an example, the calculation of Contingent Variation Margin of the RNP position in EDEBLYR-14 is executed by using a synthetic fix:

$$\text{CVM}(\text{EDEBLYR}-14)_{\text{Q1}} = \frac{€307\,873}{-5\text{MW}} \times -1\text{MW} + (€37{,}77 - €37{,}7) \times -1 \text{ MW} \times 2159\text{H} = €61\,416$$

The Contingent Variation Margin for the instrument series on side 1 is adjusted per RNP position correspondingly (Q1 as an example):

$$\text{CVM}(\text{EDEBLYR}-14)_{\text{Q1}} = \frac{€-94\,996}{1 \text{ MW}} \times 1 \text{ MW} = €-94\,996$$

The sum of net Contingent Variation Margin in every quarter will constitute the Contingent Variation Margin for the RNP position in EDEBLYR-14. Having adjusted the Contingent Variation Margin for the rest positions in instrument series on side 2, the resulting portfolio looks as follows:

Table 13: *Resulting positions after RNP and their CVM*

Instrument series	Position, MW	Hours, H	Volume, MWH	CVM, €
EDEBLQ1-14	0	2159	0	0
EDEBLQ2-14	1	2184	2184	-16085
EDEBLQ3-14	0	2208	0	0
EDEBLQ4-14	2	2209	4418	-20117
EDEBLYR-14	-4	8760	-35040	999341
RNPEDEBLYR-14	-1	8760	-8760	128275
Sum				**1091413**

The sum of Contingent Market Value of the whole portfolio after creating an RNP position (see Table 13) is different from the overall Contingent Variation Margin in the original portfolio (see Table 8). The difference can be explained by that when “switching” into RNP, the year instrument series is “cascaded” into quarter instrument series at a synthetic fix (€37,77) and not the year’s Daily Fix (€37,7). The difference between the prices is a gain or a loss, in this example a loss, which is “locked in” when creating the RNP:

$$Loss\ on\ difference = (€37{,}77 - €37{,}7) \times -1\ MW \times 8760H = €-643$$

Table 14: Comparison of CVM

	€
Sum CVM after RNP	**1 091 413**
Loss on difference	-643
Initial CVM	**1 092 056**

Example: Calculation of Futures RNP

A RNP consists of:

ENOFUTBLYR-23 - Long 280 MW, naked margin = 90 EUR

ENOFUTBLQ1-23 - Short 280 MW, naked margin = 45 EUR

ENOFUTBLQ2-23 - Short 280 MW, naked margin = 20 EUR

ENOFUTBLQ3-23 - Short 280 MW, naked margin = 10 EUR

ENOFUTBLQ4-23 - Short 280 MW, naked margin = 16 EUR

For futures RNP Initial Margin is calculated as a percentage of the sum of naked margin for all participating series.

The total margin requirement for a futures RNP will be market value + Initial Margin.

Sum over naked margin for all participating series is calculated as "90 + 45 + 20 + 10 + 16" = 181 EUR.

With the *margin percentage(%)* set to 5%, Initial Margin for the RNP would be *181 EUR * 5% = 9,05 EUR.*

Market value for future-style RNP equals sum of market values for side 1 series and market values for side 2 series.

4.2.5 Position netting within a delivery period

To calculate a Required Initial Margin, the instrument series in the portfolio are divided into Time Spread Periods which are covered by the shortest listed instrument series. If a portfolio has instrument series with opposite positions in the same Risk Group covering the same delivery period, the Initial Margin can be netted to estimate the risk on the remaining position, as described in section “Position Netting within a Delivery Period”.

Example: Position netting within a delivery period

Table 15: Portfolio of DSF instrument series

Instrument series	Position, MW	Hours, H	Volume, MWh	Delivery period	SR, €

ENLBLMJUL-14	10	744	7 440	01-31.07.2014	8,75
ENLBLQ3-14	-5	2208	-11 040	01.07-30.09.2014	8,00

Assuming that the smallest tradable instrument series are month instrument series, the instrument series in a portfolio shall be subdivided into Time Spread Periods covered by month instrument series. The instrument series in question have an overlapping Time Spread Periods in July. The net position for the time spread delivery period 01-31.07.2014 will thus be 5 MW long.

Table 16: *Time Spread Periods*

Time Spread Periods	Instrument series	Net Position, MW	Hours, H
01-31.07.2014	ENLBLMJUL-14	5	744
	ENLBLQ3-14		
01-31.08.2014	ENLBLQ3-14	-5	744
01-30.09.2014	ENLBLQ3-14	-5	720

In order to estimate the risk on a net position, SPAN® will combine 16 risk scenarios of two instrument series and define the worst combination of scenarios for the Time Spread Periods in question (see section “Position Netting within a Delivery Period).

Table 17: *Initial Margin netting within the same delivery period*

Time spread periods	**Position (MW)**	**Volume (MWh)**	**-Ext**	**-3/3**	**-2/3**	**-1/3**	**0**	**+1/3**	**+2/3**	**+3/3**	**+Ext**
01-31.07.2014 (ENLBLMJUL-14)	10	7 440	-58 627	**-65 100**	-43 375	-21 725	0	21 725	43 375	65 100	58 627
01-31.07.2014 (ENLBLQ3-14)	-5	-3 720	26 784	**29 760**	19 828	9 932	0	-9 932	-19 828	-29 760	-26 784
Net	**5**		-31 843	**-35 340**	-23 548	-11 792	0	11 792	23 548	35 340	31 843
Initial margin "worst case" (-3/3)				**-35 340**							
Initial margin rest position											
01-31.08.2014	-5	-3 720	26 784	**29 760**	19 828	9 932	0	-9 932	-19 828	-29 760	-26 784
01-30.09.2014	-5	-3 720	26 784	**29 760**	19 828	9 932	0	-9 932	-19 828	-29 760	-26 784
Sum required initial margin				-94 860							
Naked initial margin				-154 380							
Effect of netting				-59 520							

The calculation of risk scenarios is done according to sections “Risk Array Calculations” and “Naked Initial Margin” (using ENLBLMJUL-14, scenario 3/3 as an example):

$$\text{Value change}(01-31.07.2014)_{\text{ENLBLMJUN}-14;\,3/3} = 10\text{MW} \times 744\text{H} \times (\text{Round}(€8{,}75 \times -3/3); 2) = € - 65\ 100$$

A combination of risk scenarios -3/3 for both instrument series gives the worst case loss for the portfolio in question. Naked Initial Margin is calculated for the rest position.

4.2.6 Time Spread Credit due to Correlation

The next step in the Initial Margin calculation is the assessment of Time Spread credit. Time Spread Credit is applied between different Time Spread Periods with opposite exposure within the same Risk Group. A degree of crediting is dependent on the correlation level between Time Spread Periods (see section “Time Spread Credit due to Correlation”). If instrument currency is different from margin currency, Risk Array scenarios are converted at the applicable exchange rates. Time Spread Crediting is applied only to Futures, DSF and Options.

Example: Time spread netting between time spread delivery periods

Table 18: *Portfolio of Future and Option instrument series*

Instrument series	Position, MW	Hours, H	Volume, MWh	Time Periods	Spread	Composite delta	Correlation
EDEBLCY4DEC3-39	1	8760	8760	01.01-31.12.2014		0,2977	0,97
EDEBLYR-15	-1	8760	-8760	01.01-31.12.2015		N/A	

For the instrument series in question, SPAN® presents the following theoretical value changes in 16 scenarios:

Table 19: *Theoretical value changes of DSF and Option*

Scenario	Theoretical value change EDEBLYR-15	Theoretical value change EDEBLCYR4DEC3-39
1	0	0,21
2		-0,12
3	1,79	0,69
4		0,33
5	-1,79	-0,18
6		-0,48
7	3,59	1,25
8		0,87
9	-3,59	-0,5
10		-0,74
11	5,38	1,89
12		1,51
13	-5,38	-0,74
14		-0,94
15	4,84	2,09
16	-4,84	-0,37

The following results are received when entering these values into the calculation of theoretical value changes per position and Time Spread Periods:

Table 20: Theoretical value changes for Option position

Time spread period	Position (MW)	Volume (MWh)	Implied volatlity	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
01.01-31.12.2014	1	8 760	Up	-3 241	-6 482	-4 380	-1 577	1 840	6 044	10 950	16 556	18 308
EDEBLCYR4DEC-39			Down	-3 241	**-8 234**	-6 482	-4 205	-1 051	2 891	7 621	13 228	61 145

Table 21: Theoretical value changes for DSF position

Time spread period	Position (MW)	Volume (MWh)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
01.01-31.12.2015	-1	-8 760	42 398	47 129	31 448	15 680	0	-15 680	-31 448	**-47 129**	-42 398
EDEBLYR-15											

The calculation of risk scenarios is done according to section "Risk Array Calculations" and "Naked Initial Margin" (using 3/3 scenario as an example):

$$\text{Value change}(01.01-31.12.2014)_{\text{EDEBLCYR4DEC-39;3/3; up}} = 1\text{MW} \times 8760\text{H} \times €1{,}89 = €16\,556$$

$$\text{Value change}(01.01-31.12.2015)_{\text{EDEBLYR-15; 3/3}} = -1\text{MW} \times 8760\text{H} \times €5{,}38 = €-47\,129$$

The worst case scenarios for EDEBLCY4DEC-39 and EDEBLYR-15 are the scenarios -3/3 (volatility down) and +3/3 respectively.

The Time Spread Periods in question demonstrate a correlation of 0,97 and have opposite exposure which allow for a Time Spread Credit. Options' energy contribution to time spread is dependent on a composite delta. For the Option in question, delta/volume used in time spread is:

$$\text{Delta}(01.01-31.12.2014)_{\text{EDEBLCYR4DEC-39}} = 1\text{MW} \times 8760\text{H} \times 0{,}2977 = 2608\text{ MWH}$$

The volume credited in time spread is maximized to the smallest amount of energy available in the Time Spread Periods. Having adjusted the theoretical values for the time spread delta, the following results are calculated for the portfolio in question:

Table 22: Time Spread Credit between different Time Spread Periods

Time spread periods	Contracts	Volume (MWh)	Implied volatlity	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
01.01-31.12.2014	EDEBLCYR4DEC-39	2 608	Up	-3 241	-6 482	-4 380	-1 577	1 840	6 044	10 950	16 556	18 308
			Down	-3 241	-8 234	-6 482	-4 205	-1 051	**2 891**	7 621	13 228	18 308
01.01-31.12.2015	EDEBLYR-15	-2 608		12 623	14 031	9 363	4 668	0	-4 668	**-9 363**	-14 031	-12 623
Net (1 step)				9 382	7 549	2 880	288	-1 577	-2 829	-3 318	-3 081	5 686
				9 382	5 797	1 128	-1 814	-4 205	-5 720	**-6 472**	-6 410	5 686
Initial margin "worst case" (+2/3&+1/3)				**-6 472**								
Initial margin rest volume												
01.01-31.12.2015		-6 152		29 776	33 098	22 086	11 012	0	-11 012	-22 086	-33 098	-29 776
Sum required initial margin				-39 570								
Naked initial margin				-55 363								
Effect of time spread netting				-15 794								

The calculations of scenarios are performed in the following way (using data from Table 18, 20 and 21 and scenario +3/3 as an example):

$$\text{Value change}(01.01-31.12.2014)_{\text{EDEBLCYR4DEC-39;3/3; up}} = \frac{€16\,556}{2608\text{H}} \times 2608\text{H} = €16\,556$$

$$\text{Value change}(01.01-31.12.2015)_{\text{EDEBLYR-15; 3/3}} = \frac{€-47\,129}{8760\text{H}} \times 2608\text{H} = €-14\,030$$

As correlation is 0,97, the worst case for the combination of scenarios is examined within one step (see section "Determining the Worst Case Scenario"). For the instrument series in question, the worst combination will be for scenarios +1/3 and +2/3 (volatility down).

4.2.7 Inter Commodity Spread Credit

The last stage in the calculation of Required Initial Margin is the calculation of Inter Commodity Spread Credit. Inter Commodity Spread Credit based on the correlation between different markets (different Risk Groups) after all netting effects within the same Risk Group. The methodology of Inter Commodity Spread Credit evaluation is available in the section "Inter Commodity Spread Credit".

Example: Inter Commodity Spread Credit calculation

Table 23: *Portfolio of DSF instrument series*

Time Spread Periods	Instrument series	Position, MW	Hours, H	Volume, MWh	WRA, €	Naked IM, €
01-31.06.2014	ENOMJUN-14	-10	720	-7200	10,03	-72 216
01.07-30.09.2014	EDEBLQ3-14	10	2208	22 080	-6,78	-149 702

In order to calculate Inter Commodity Spread Credit between two Time Spread Periods, tiers of instrument series which cover the Time Spread Periods, delta ratios between tiers and credit spread have to be identified. The following information is available for the Time Spread Periods in question:

Table 24: *ICSC variables*

Tier 1102:	ENOMJUN-14	
Tier 2202:	EDEBLQ3-14	
Instrument series spread	**Delta ratio**	**Credit spread**
Tier 1102 : Tier 2202	0,425	0,57

The delta ratios determine how much energy per Time Spread Periods will participate in the Inter Commodity Spread Credit. Using data from Tables 23 and 24, the ICSC delta can be determined (period of 01-31.06.2014 as an example):

$$\text{ICSC delta}(01-30.06.2014)_{\text{ENOMJUN}-14} = \frac{-7200\text{MWH}}{10} = -720\text{ MWH}$$

After ICSC deltas are calculated for both Time Spread Periods, the absolute minimum delta is chosen. The absolute minimum delta determines the amount of energy on which credit will be calculated. The credit in € is obtained as follows (period of 01-31.06.2014 as an example and using data from tables 23 and 24):

$$\text{Credit}(01-30.06.2014)_{\text{ENOMJUN}-14} = \text{ABS}\left(-\frac{720\text{MWH}}{720\text{MWH}} \times € - 72\ 216 \times 0{,}57\right) = €41\ 163$$

Table 25 summarizes the calculation of ICSC for both Time Spread Periods and demonstrates the overall reduction in the Initial Margin:

Table 25: *ICSC calculations*

Time spread periods	Product	Naked IM, €	Delta ratios	Original delta, MWh	ICSC Delta, MWh	ABS Delta, MWh	Min Delta, MWh	Credit spread, %	Credit, €
01-30.06.2014	ENOMJUN-14	-72 216	10	-7 200	-720	720	720	57,00 %	41 163
01.07-30.09.2014	EDEBLQ3-14	-149 702	12	22 080	1 840	1 840	720	57,00 %	33 390

Product	Naked IM, €	Required IM, €	Effect of ICSC, €
ENOMJUN-14	-72 216	-31 053	-41 163
EDEBLQ3-14	-149 702	-116 312	-33 390
Sum	**-221 918**	**-147 365**	**-74 553**

Example: Inter Commodity Spread Credit calculation II

Table 26: *Portfolio of DSF and EPAD instrument series*

Time Spread Periods	Instrument Series	Position, MWh	Hours, h	Volume, MWh	WRA, €	Naked IM, €
01-30.06.2015	ENOMJUN-15	10	720	7 200	-2.75	-19 800
01-30.06.2015	SYARHJUN-15	10	720	7 200	-1.45	-10 440

The following information is available for the Time Spread Periods in question:

Table 27: *ICSC variables*

Tier 1103: ENOMJUN-15

Tier 64103: SYARHJUN-15

Instrument series spread	Delta ratio	Credit spread	A/B
Tier 1103 : Tier 64103	10/18	0.67	A/A

The delta ratio determines the amount of energy per Time Spread Period that will participate in the Inter Commodity Spread Credit. A/B determines whether the positions must be in the same or opposite directions to participate in the Inter Commodity Spread Credit. A/B means that the positions must be long/short or short/long to participate. A/A means that the positions must be long/long or short/short to participate. Using data from Tables 26 and 27, the ICSC delta can be determined:

$$\text{ICSC delta}(01-30.06.2015)_{\text{ENOMJUN}-15} = \frac{-7200\text{MWh}}{10} = -720\text{ MWh}$$

$$\text{ICSC delta}(01-30.06.2015)_{\text{SYARHJUN}-15} = \frac{-7200\text{MWh}}{18} = -400\text{ MWh}$$

After ICSC deltas are calculated for both Time Spread Periods, the absolute minimum delta is chosen. The absolute minimum delta determines the amount of energy on which credit will be calculated. The credit in € is obtained as follows (period of 01-31.06.2014 as an example and using data from tables 26 and 27):

$$\text{Credit}(01-30.06.2015)_{\text{ENOMJUN}-15} = \text{ABS}\left(-\frac{400\text{MWh}}{720\text{MWh}} \times € - 19\,800 \times 0{,}67\right) = €7\,370$$

$$\text{Credit}(01-30.06.2015)_{\text{SYARHJUN}-15} = \text{ABS}\left(-\frac{400\text{MWh}}{400\text{MWh}} \times € - 10\,440 \times 0{,}67\right) = €6\,995$$

Table 28 summarizes the calculation of ICSC for both Time Spread Periods and demonstrates the overall reduction in the Initial Margin:

Table 28: *ICSC calculations*

Time Spread Periods	Instrument Series	Naked IM, €	Delta ratios	Original delta, MWh	ICSC Delta, MWh	ABS Delta, MWh	Min Delta MWh	Credit spread, %	Credit, €
01-30.06.2015	ENOMJUN-15	-19 800	10	7 200	720	720	400	67 %	7370
01-30.06.2015	SYARHJUN-15	-10 400	18	7 200	400	400	400	67 %	6995

Instrument series	Naked IM, €	Required IM, €	Effect of ICSC, €
ENOMJUN-15	-19 800	-12 430	-7370
SYARHJUN-15	-10 440	-3 445	-6995
Sum			

Appendix D - ELECTRICITY CERTIFICATE MARKETS

This appendix provides details on margining of Electricity Certificate cleared at Nasdaq Clearing. Table 29 below presents an overview of Electricity Certificate market.

Table 29: *Electricity Certificate market overview*

Product type	Product	Instrument currency
Electricity Certificate	DSF	EUR

4.3 Contingent Variation Margin calculation

The Contingent Variation Margin is calculated for an electricity Deferred Settlement Future in the trading period (see section "Contingent Variation Margin of DSF and EPAD DSF").

Example: Calculation of Contingent Variation Margin in a trading period

Product	Deferred Settlement Future
Instrument series	ELCEURMAR-14
Position	-1
Certificates	1000 C
Trade price	€ 20
Daily Fix	€ 22
# of trades	1

The Contingent Variation Margin for the Deferred Settlement Future ELCEURMAR-14 is calculated using Formula:

$$CVM(ELCEURMAR-14) = (€22 - €20) \times -1 \times 1000\ C = € - 2000$$

4.4 Initial Margin calculation

The Initial Margin is calculated for an Electricity Certificate Deferred Settlement Future in the trading period. Initial Margin increases significantly the last week before the last trading day to reflect the risk of approaching physical delivery and settlement. Examples below illustrate step by step calculation of Initial Margin.

4.4.1 Estimating Risk Interval in % and currency

Example: Calculation of Risk Interval in % and currency (scanning range)

Product	Deferred Settlement Future
Instrument series	ELCEURMAR-14
Days to start of delivery	32 d
Days to stop of delivery	32 d

Daily Fix	€ 19

In order to estimate a Risk Interval for the Deferred Settlement Future instrument series in question, the principles described in section 3 “Calculation of the Risk Interval) shall be applied. A starting point is to obtain a volatility matrix for the market in question:

Table 30: *Example of volatility table for Electricity Certificates Market*

Days to start and stop of delivery	Risk Interval
1	10,05 %
8	10,05 %
15	10,05 %
22	10,05 %
29	10,05 %
36	10,00 %
43	10,00 %

The Risk Interval for the instrument series where the delivery period constitutes one day and is between two observations will be the same as the Risk Interval in the point closer to delivery. As ELCEURMAR-17 has 32 days to start and stop of delivery, the Risk Interval for this instrument series will be equal to 10,05% (the same as for 29 days to start and stop of delivery).

Risk Interval in the instrument series currency (scanning range) will be:

$$\mathrm{RI(ELCEURMAR-17)} = 10{,}05\% \times €19 = €2$$

Example 1: Risk Interval in % approaching the last trading day

The Risk Interval for Electricity Certificate instrument series approaching delivery gradually increases up to 100% to accommodate a change from price to a delivery/settlement risk: the net seller has to deliver allowances and the net buyer has to pay for the product. The Table 31 illustrates a Risk Interval for Electricity Certificate instrument series approaching delivery:

Table 31: Example of volatility matrix for emissions instrument series approaching delivery

Days to start and stop of delivery	Risk Interval
1	100,00 %
2	85,00 %
3	70,00 %
4	55,00 %
5	40,00 %
6	30,00 %
7	20,00 %

Example: Risk Array calculation

Product	Deferred Settlement Future
Instrument series	ELCEURMAR-14

Delivery period	13.03.2014
Daily Fix	€ 19

As described in the section "Risk Array Calculation", the next step in the calculation of Initial Margin is estimation of risk scenarios. Based on the data above, the following risk scenarios are available for ELCEURMAR-14:

Table 32: *Example of Risk Array calculation for Deferred Settlement Future*

Scenario	Theoretical price scenario	Implied volatility	Theoretical value change ELCEURMAR-14
1	23,9	-	0
2		-	
3	24,7	-	0,8
4		-	
5	23,1	-	-0,8
6		-	
7	25,5	-	1,6
8		-	
9	22,3	-	-1,6
10		-	
11	26,3	-	2,4
12		-	
13	21,5	-	-2,4
14		-	
15	31,1	-	2,16*
16	16,7	-	-2,16*

*theoretical value changes in extreme scenarios are weighted with a factor 0,3 (+/-7,2x0,3)

4.4.2 Estimating naked Initial Margin

After the scanning range and the risk scenarios are estimated, the scenario generating the greatest potential loss will constitute the Naked Initial Margin.

Example: Naked Initial Margin calculation in a trading period

Product	Deferred Settlement Future
Instrument series	ELCEURMAR-14
Delivery period	13.03.2014
Position	-1
Certificates	1000 C
Daily Fix	€ 23,9

Risk Array	See Table 32

For the instrument series in question, the worst case scenario will be scenario 11 – a price increase by 3/3 of the scanning range. Applying Formula 6, the naked Initial Margin for the Deferred Settlement Future ELCEURMAR-14 will be:

$$IM_{naked}(ELCEURMAR-14) = -1 \times 1000\ C \times Round(€2{,}4; 2) = € - 2400$$

4.4.3 Time Spread Credit

For the purpose of calculating Required Initial Margin, the instrument series in the portfolio are divided into Time Spread Periods which are covered by the shortest listed instrument series. Time Spread Credit is applied between Time Spread Periods with opposite exposure within the same Risk Group. The degree of crediting is dependent on the correlation level between Time Spread Periods (see section Time Spread Credit due to Correlation).

Example: Time spread netting between different Time Spread Periods

Table 33: *Portfolio of Deferred Settlement Future instrument series*

Instrument series	Position	Certificates, C	Volume, C	Time Spread Period	Correlation
ELCEURMAR-14	-1	1000	-1000	13.03.2014	0,87
ELCEURMAR-15	2	1000	2000	13.03.2015	

For the instrument series in question, SPAN® gives the following theoretical value changes in 16 scenarios:

Table 34: *Theoretical value changes of Futures*

Scenario	Theoretical value change ELCEURMAR-14	Theoretical value change ELCEURMAR-15
1	0	0
2		
3	0,73	0,8
4		
5	-0,73	-0,8
6		
7	1,47	1,6
8		
9	-1,47	-1,6
10		
11	2,2	2,4
12		
13	-2,2	-2,4
14		
15	1,98	2,16
16	-1,98	-2,16

The following results are received when entering these values into the calculation of theoretical value changes per position and Time Spread Period:

Table 35: *Theoretical value changes for DSF position ELCEURMAR-14*

Time spread period	Position	Volume (C)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
13.03.2014	-1	-1 000	1 980	2 200	1 470	730	0	-730	-1 470	**-2 200**	-1 980
ELCEURMAR-14											

Table 36: *Theoretical value changes for DSF position ELCEURMAR-15*

Time spread period	Position	Volume (C)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
13.03.2014	2	2000	-4 320	**-4 800**	-3 200	-1 600	0	1 600	3 200	4 800	4 320
ELCEURMAR-15											

The calculation of risk scenarios is done according to sections "Risk Array Calculations" and "Naked Initial Margin" (using -3/3 scenario as an example):

$$Value\ change(13.03.2013)_{ELCEURMAR-14;\,-3/3} = -1 \times 1000C \times € - 2{,}2 = €2200$$

$$Value\ change(13.03.2014)_{ELCEURMAR-15;-\,3/3} = 2 \times 1000C \times € - 2{,}4 = € - 4800$$

The worst case scenarios for ELCEURMAR-14 and ELCEURMAR-15 are scenarios -3/3 and +3/3 respectively.

The Time Spread Periods in question demonstrate a correlation of 0,87 and have opposite exposure which allow for a Time Spread Credit. The volume credited in the time spread is maximized to the smallest volume available in the Time Spread Periods. The following combination of Risk Array scenarios is received for the portfolio in question:

Table 37: *Time spread netting between different Time Spread Periods*

Time spread periods	Instrument seriess	Volume (C)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
13.03.2014	ELCEURMAR-14	-1 000	1 980	2 200	1 470	**730**	0	-730	-1 470	-2 200	-1 980
13.03.2015	ELCEURMAR-15	1 000	-2 160	**-2 400**	-1 600	-800	0	800	1 600	2 400	2 160
Net (2 steps)			-180	-1 670	-1 600	-1 530	-1 470	-1 400	-600	200	180
Initial margin "worst case" (-3/3&-1/3)				**-1 670**							
Initial margin rest volume											
13.03.2015			1 000	-2 160	**-2 400**	-1 600	-800	0	800	1 600	2 400
Sum required initial margin				-4 070							
Naked initial margin				-7 000							
Effect of time spread netting				-2 930							

The calculations of scenarios are performed in the following way (using data from Tables 35, 36 and 37 and scenario -3/3 as an example):

$$Value\ change(13.03.2014)_{ELCEURMAR-14;-\frac{3}{3}} = \frac{€2200}{-1} \times -1 = €2200$$

$$Value\ change(13.03.2015)_{ELCEURMAR-15;-3/3} = \frac{€-4800}{2} \times 2 = €-2400$$

As correlation between Time Spread Periods is 0,87, the worst case for the combination of scenarios is examined within two steps (see section “Determining the Worst Case Scenario”). For the portfolio in question, the worst combination is for scenarios -3/3 and -1/3.

4.4.4 Inter Commodity Spread Credit

The last stage in the calculation of Required Initial Margin is the calculation of Inter Commodity Spread Credit. Inter Commodity Spread Credit is applied on Time Spread Periods based on the correlation between different markets (different Risk Groups) after all netting effects within the Risk Group. The methodology of Inter Commodity Spread Credit evaluation is available in section “Inter Commodity Spread Credit”.

Example: Inter Commodity Spread Credit calculation

Table 38: *Portfolio of Deferred Settlement Future*

Time Spread Period	Instrument series	Position	Certificates/ Hours	Volume	WRA, €	Naked IM, €
13.03.2015	ELCEURMAR-15	-1	1000	-1000	2,45	-2450
01-31.07.2015	ENOMJUL-15	1	744	744	-7,12	-5297

In order to be able to calculate an Inter Commodity Spread Credit between Time Spread Periods, tiers of instrument series which cover Time Spread Periods, delta ratios between tiers and credit spread have to be identified. The following information is available for the instrument series in question:

Table 39: *ICSC variables*

Tier 9109:	ELCEURMAR-15
Tier 1105:	ENOMJUL-15

Instrument series spread	Delta ratio	Credit spread
Tier 9101 : Tier 1105	10:30	40 %

Delta ratios will determine the volume per Time Spread Period participating in the Inter Commodity Spread Credit. Using data from table 38 and 39, the ICSC delta can be determined (period of 13.03.2015 as an example):

$$ICSC\ delta(13.03.2015)_{ELCEURMAR-15} = \frac{-1000C}{10} = -100\ C$$

After ICSC deltas are calculated for both Time Spread Periods, the absolute minimum delta is chosen. The absolute minimum delta determines the volume on which credit will be calculated. The credit in € is obtained as follows (period of 13.03.2014 as an example and using data from tables 38 and 39):

$$Credit(13.03.2015)_{ELCEURMAR-15} = ABS\left(-\frac{25C}{100C} \times €-2450 \times 0{,}4\right) = €243$$

Table 40 summarizes the calculation of ICSC for both Time Spread Periods as well as demonstrates the overall reduction in the Initial Margin:

Table 40: *ICSC calculations*

Time spread periods	Product	Naked IM, €	Delta ratios	Original delta, C/MWh	ICSC Delta, C/MWh	ABS Delta, C/MWh	Min Delta, C/MWh	Credit spread, %	Credit, €
13.05.2015	ELCEURMAR-15	-2 450	10	-1 000	-100	100	25	40,00 %	243
01-31.07.2015	ENOMJUL-15	-5 297	30	744	25	25	25	40,00 %	2 119

Product	Naked IM, €	Required IM, €	Effect of ICSC, €
ELCEURMAR-15	-2 450	-2 207	-243
ENOMJUL-15	-5 297	-3 178	-2 119
Sum	**-7 747**	**-5 385**	**-2 362**

4.5 Payment Margin calculation

Electricity Certificate Deferred Settlement Future payment margin shall ensure the forthcoming settlement (see section Payment Margin). The payment margin is calculated from end-of-day on the Expiration day until (not including) end-of-day the business day before the settlement day.

Example: Payment margin calculation for Deferred Settlement Future

Product	Deferred Settlement Future
Instrument series	ELCEURMAR-14
Position	+5
Tonnes	1000 C
Trade price	€10
Expiration fix	€8

As for DSF instrument series payment margin equals a sum of the value of the position at expiration fix and Contingent Variation Margin on the expiration day (see section Payment margin), the calculation of payment margin for the instrument series in question will be performed in the following way:

Long position:

$$Payment\ margin(ELCEURMAR-14) = -(€\,8 \times 5 \times 1000\ C) + (€\,8 - €10) \times 5 \times 1000\ C = € - 50\ 000$$

Short position:

$$Payment\ margin(ELCEURMAR-14) = -(€\,8 \times 5 \times 1000\ C) + (€\,8 - €10) \times -5 \times 1000\ C = €50\ 000$$

Appendix E - **ALLOWANCE MARKETS**

This appendix illustrates a margining of Allowance derivatives markets cleared at Nasdaq Clearing. The table 41 below presents an overview of Allowance markets.

***Table 41**: Allowance markets cleared at Nasdaq Clearing*

Product type	Product	Instrument currency
European Union Allowances	Day Future, Future, DFS, Option	EUR
Certified Emission Reductions	Day Future, Future, Option	EUR
European Union Aviation Allowances	Future	EUR

4.6 Contingent Variation Margin calculation

The Contingent Variation Margin is calculated for Allowance Deferred Settlement Future (DSF) in the trading period. Market Value is applied for Option instrument series in the trading period. Allowance Futures are subject to a daily mark-to-market settlement and the Contingent Variation Margin is included as a margin component only on intra-day basis. In the end-of-day margin requirement calculation, the Contingent Variation Margin for Future instrument series is 0 (see section “Market Valuation”).

Example: Calculation of Contingent Variation Margin in a trading period

Product	Deferred settlement Future
Instrument series	EUADEC-14
Position	+5 lots
Tonnes	1000 T
le price	€10
Daily fix	€8
# of trades	1

The Contingent Variation Margin for the DSF EUADEC-14 is calculated using Formula:

$$CVM(EUADEC-14) = (€\,8 - €10) \times 5\ lots \times 1000\ T = -€10\ 000$$

Example: Calculation of Market Value in a trading period

Product	Option on Future
Instrument series	NCCDEC3-10
Position	-10 lots
Tonnes	1000 T
Trade price	€1

Daily fix	€0,5
# of trades	1

The Market Value for the Option instrument series in question is obtained by using Formula:

$$MV(NCCDEC3 - 10) = € \, 0{,}5 \times \; -10 \; MW \times 1000 \; T = € - 5000$$

4.7 Initial Margin calculation

The Initial Margin is calculated for Allowance Futures, Deferred Settlement Future and Options in the trading period. Initial Margin increases significantly the last week before the last trading day to reflect the risk of approaching physical delivery and settlement. Examples below illustrate step by step calculation of the Initial Margin.

4.7.1 Estimating risk interval in % and currency

Example: Calculation of risk interval in % and currency (scanning range)

Product	Future
Instrument series	NAVEMAR4
Delivery Period	31.03.2014
Days to start of delivery	18 d
Days to stop of delivery	19 d
Daily Fix	€ 8

In order to estimate a Risk Interval of the Future instrument series in question, the principles described “Calculation of the Risk Interval” shall be applied. A starting point is to obtain a volatility table for the market in question:

Table 42: *Example of volatility table for Allowance market*

Days to start and stop of delivery	Risk Interval
1	100,00 %
8	70,00 %
15	60,00 %
22	50,00 %
29	50,00 %
36	50,00 %
43	50,00 %

The risk interval for the contract where the delivery period constitutes one day and is between two observations will be the same as the risk interval in the point closer to delivery. As NAVEMAR4 has 18 days to start and 19 days stop of delivery, the risk interval for this contract will be equal to 60% (the same as for 15 days to start and stop to delivery).

The Risk Interval in the instrument series currency (scanning range) is calculated as follows:

$$RI(NAVEMAR4) = 60\% \times €8 = €4{,}8$$

Example2: Risk interval in % approaching the last trading day

The Risk interval of Allowance instrument series approaching delivery gradually increases up to 100% to accommodate a change from price to a delivery/settlement risk: the net seller has to deliver allowances and the net buyer has to pay for the product. The Table 43 illustrates a risk interval for Allowance instrument series approaching delivery:

Table 43: Example of volatility table for Allowance instrument series approaching delivery

Days to start and stop of delivery	Risk Interval
1	100,00 %
2	95,00 %
3	90,00 %
4	85,00 %
5	80,00 %
6	75,00 %
7	70,00 %

Example 3: *Risk Array calculation*

Product	Future
Contract	NEDEC4
Delivery period	15.12.2014
Scanning range	€3,77
Daily fix	€5,46

As described in the section "Risk Array Calculation", the next step in the calculation of Initial Margin is estimation of risk scenarios. Based on the data above, the following risk scenarios are available for NEDEC4:

Table 44: *Example of Risk Array calculation for Future*

Scenario	Theoretical price scenario	Implied volatility	Theoretical value change NEDEC4
1	5,46	-	0
2		-	
3	6,72	-	1,26
4		-	
5	4,2	-	-1,26
6		-	
7	7,97	-	2,51

8		-	
9	2,95	-	-2,51
10		-	
11	9,23	-	3,77
12		-	
13	1,69	-	-3,77
14		-	
15	12,23	-	3,39*
16	0,54	-	-1,64**

*theoretical value changes in extreme scenarios are weighted with a factor 0,3 (+/-11,30x0,3)
**under assumption that daily fix cannot be negative for this instrument series

Example: Risk Array calculation

Product	Option
Contract	NCPDEC4-5
Underlying contract	NCDEC4
Delivery period of underlying future	15.12.2014
Scanning range	€3,77
Daily fix for underlying DSF	€5,46
Implied volatility	12,8%

In the estimation of a Risk Array for Option instrument series, implied volatility is a factor to be considered. Theoretical values and value changes are calculated for seven different prices for the underlying derivative combined with two volatility scenarios (high and low) and two extreme scenarios where prices of the underlying derivative exceed the scanning range (unchanged implied volatility). Inserting the available variables into Black-76 model (see section "Risk Array Calculations"), the following risk scenarios are obtained for the instrument series in question:

Table 45: *Example of Risk Array calculation for Option*

Scenario	Theoretical price scenario for underlying DFS	Implied volatility (+20%, -12%)	Theoretical value change NCPDEC4-5	Theoretical value change NCPDEC4-5
1	5,46	15,36 %	0,56	-0,09
2		11,26 %	0,48	-0,17
3	6,72	15,36 %	0,51	-0,14
4		11,26 %	0,42	-0,23
5	4,2	15,36 %	0,61	-0,04
6		11,26 %	0,55	-0,1
7	7,97	15,36 %	0,47	-0,18
8		11,26 %	0,36	-0,29
9	2,95	15,36 %	0,66	0,01

10		11,26 %	0,61	-0,04
11	9,23	15,36 %	0,42	-0,23
12		11,26 %	0,3	-0,35
13	1,69	15,36 %	0,71	0,06
14		11,26 %	0,67	0,02
15	12,23	12,80 %	0,47	-0,18*
16	0,54	12,80 %	0,77	0,12*

**theoretical value changes in extreme scenarios are weighted with a factor 0,3 (-0,59 x0,3 in scenario 15 and 0,41x0,3 in scenario 16)*

4.7.2 Estimating Naked Initial Margin

After scanning range and risk scenarios are estimated, the scenario generating the greatest potential loss will constitute a Naked Initial Margin.

Example: Naked Initial Margin calculation in the trading period

Product	Future
Contract	NEDEC4
Delivery period	15.12.2014
Position	+1 lot
Tonnes	1000 T
Daily fix	€5,46
Risk array	See table 4

For the instrument series in question, the worst case scenario is scenario 13 – a price decrease by 3/3 of the scanning range. Applying Formula 6, the Naked Initial Margin for the Future NEDEC4 is:

$$IM_{naked}(NEDEC4) = 1\ lot \times 1000\ T \times € - 3{,}77 = € -\ 3770$$

Example: Naked Initial Margin calculation in a trading period

Product	Option
Contract	NCPDEC4-5
Underlying contract	NCDEC4
Delivery period of underlying DFS	15.12.2014
Position	-5 lots
Daily fix for underlying DFS	€5,46
Implied volatility	12,8%
Risk array	See table 5

Taking into account the direction of position, the greatest loss for the portfolio consisting of this instrument series will be in the scenario 13 – a price increase by 3/3 of the scanning range for underlying Future and an increase in the implied volatility level by 20% (see Table 45). Applying Formula 6, the Naked Initial Margin for this Option instrument series will be:

$$IM_{naked}(NCPDEC4) = -5\ lots \times 1000\ T \times €0{,}06 = € -\ 300$$

4.7.3 Time Spread Credit

For the purpose of calculating Required Initial Margin, the instrument series in portfolio are divided into Time Spread Periods which are covered by the shortest listed instrument series. Time Spread Credit is applied between different delivery periods with opposite exposure covered by instrument series within the same Risk Group. A degree of crediting is dependent on the correlation level between delivery periods (see section “Time Spread Credit due to Correlation”).

Example: Time spread netting between different delivery periods

Table 46: *Portfolio of Future instrument series*

Instrument series	Position, lots	Tonnes, H	Volume, lotsxtonnes	Time spread periods	Correlation
NAVEDEC3	80	1000	80 000	16.12.2013	0,97
NAVEDEC4	-40	1000	-40 000	15.12.2014	

For the instrument series in question, SPAN® presents the following theoretical value changes in 16 scenarios:

Table 47: *Theoretical value changes of Futures*

Scenario	Theoretical value change NAVEDEC3	Theoretical value change NAVEDEC4
1	0	0
2		
3	1,64	1,67
4		
5	-1,64	-1,67
6		
7	3,27	3,34
8		
9	-3,27	-3,34
10		
11	4,91	5,01
12		
13	-4,91	-5,01
14		
15	4,42	4,51
16	-4,42	-4,51

Applying these values into the calculation of theoretical value changes per position and delivery interval, the following results are received:

Table 48: *Theoretical value changes for Future position NAVEDEC3*

Time spread period	Position (lots)	Volume (tonnesx lots)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
16.12.2013 NAVEDEC3	80	80 000	-353 600	**-392 800**	-261 600	-131 200	0	131 200	261 600	392 800	353 600

Table 49: *Theoretical value changes for Future position NAVEDEC3*

Time spread period	Position (lots)	Volume (tonnesx lots)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
15.12.2014 NAVEDEC4	-40	-40 000	180 400	200 400	133 600	66 800	0	-66 800	-133 600	**-200 400**	-180 400

The calculation of risk scenarios is done according to section "Risk Array Calculations" and "Naked Initial Margin" (using -3/3 scenario as an example):

$$Value\ change(16.12.2013)_{NAVEDEC3;\, -\frac{3}{3}} = 80\ lots \times 1000T \times € - 4{,}91 = € - 392\ 800$$

$$Value\ change(15.12.2014)_{NAVEDEC4; -\frac{3}{3}} = -40\ lots \times 1000T \times € - 5{,}01 = €200\ 400$$

The worst case scenarios for NAVEDEC3 and NAVEDEC4 will be scenarios -3/3 and +3/3 respectively.

The Time Spread Periods in question demonstrate a correlation of 0,97 and have opposite exposure which allow for time spread. The volume credited in time spread is maximized to the smallest amount of volume available in Time Spread Periods. The following combination of Risk Array scenarios is received for the portfolio in question:

Table 50: *Time Spread netting between different Time Spread Periods*

Time spread periods	Instrument series	Volume (tonnes x lots)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
16.12.2013	NAVEDEC3	40 000	-176 800	-196 400	-130 800	-65 600	0	65 600	**130 800**	196 400	176 800
15.12.2014	NAVEDEC4	-40 000	180 400	200 400	133 600	66 800	0	-66 800	-133 600	**-200 400**	-180 400
Net (1 step)			3 600	-62 800	-64 000	-65 600	-66800	-68 000	**-69 600**	-4 000	-3 600
Initial margin "worst case" (+3/3&2/3)					**-69 600**						
Initial margin rest volume											
16.12.2013		40 000	-176 800	**-196 400**	-130 800	-65 600	0	65 600	130 800	196 400	176 800
Sum required initial margin					-266 000						
Naked initial margin					-593 200						
of time spread netting					-327 200						

The calculations of scenarios are performed in the following way (using data from Table 48, 49 and 50 and scenario 3/3 as an example):

$$Value\ change(16.12.2013)_{NAVEDEC3;3/3} = \frac{€392\ 800}{80\ lots} \times 40\ lots = €196\ 400$$

$$Value\ change(15.12.2014)_{NAVEDEC4;\,3/3} = \frac{€-20\ 400}{40\ lots} \times 40\ lots = €-200\ 400$$

As correlation between Time Spread Periods is 0,97, the worst case for the combination of scenarios is examined within one step (see section “Determining the Worst Case Scenario”). For the instrument series in question, the worst combination will be for scenarios +3/3 and +2/3.

4.7.4 Inter Commodity Spread Credit

The last stage in the calculation of Required Initial Margin is the calculation of Inter Commodity Spread Credit. Inter Commodity Spread Credit is applied on Time Spread Periods based on the correlation between different markets (different Risk groups) after all netting effect within the same Risk Group. The methodology of Inter Commodity Spread Credit evaluation is available in “Inter Commodity Spread Credit”.

Example: Inter Commodity Spread Credit calculation

Table 51: *Portfolio of Future instrument series*

Time spread period	Instrument series	Position, lots	Tonnes, T	Volume, tonnesxlots	WRA, €	Naked IM, €
16.12.2014	NEMAR4	-5	1000	-5 000	3,82	-19 100
15.12.2015	NCDEC5	15	1000	15 000	-0,64	-9 600

In order to be able to calculate an Inter Commodity Spread Credit between Time Spread Periods, tiers of instrument series which cover Time Spread Periods, delta ratios between tiers and credit spread have to be identified. The following information is available for the instrument series in question:

Table 52: *ICSC variables*

Tier 3103:	NEMAR4
Tier 4107:	NCDEC5

Instrument series spread	Delta ratio	Credit spread
Tier 3103 : Tier 4107	10:20	60%

Delta ratios will determine how much volume per time spread period will participate in the Inter Commodity Spread Credit. Using data from table 51 and 52, the ICSC delta can be determined (period of 16.12.2014 as an example):

$$ICSC\ delta(16.12.2014)_{NEMAR4} = \frac{-5000T}{10} = -500\ Tonnes$$

After ICSC deltas are calculated for both Time Spread Periods, the absolute minimum delta is chosen. The absolute minimum delta determines the volume on which credit will be calculated. The credit in € is obtained as follows (period of 16.12.2014 as an example and using data from Tables 51 and 52):

$$Credit(16.12.2014)_{NEMAR4} = ABS\left(-\frac{500\ T}{500\ T} \times €-19\ 100 \times 0{,}6\right) = €11\ 460$$

Table 53 summarizes the calculation of ICSC for both Time Spread Periods as well as demonstrates the overall reduction in the Initial Margin:

Table 53: *ICSC calculations*

Time spread periods	Instrument series	Naked IM, €	Delta ratios	Original delta, T	ICSC Delta, T	ABS Delta, T	Min Delta, T	Credit spread, %	Credit, €
16.12.2014	NEMAR4	-19 100	10	-5 000	-500	500	500	60,00 %	11 460
15.12.2015	NCDEC5	-9 600	20	15 000	750	750	500	60,00 %	3 840

Instrument series	Naked IM, €	Required IM, €	Effect of ICSC, €
NEMAR4	-19 100	-7 640	-11 460
NCDEC5	-9 600	-5 760	-3 840
Sum	**-28 700**	**-13 400**	**-15 300**

4.8 Payment Margin calculation

Payment margin is calculated for a net long position in of Allowance day Futures and Futures to ensure the forthcoming settlement (see section Payment Margin). The payment margin is calculated from end-of-day on the Expiration day until (not including) end-of-day the business day before the settlement day.

Example: Payment margin calculation for Futures

Product	Day Future
Contract	NCD3009-13
Position	10 lots
Tonnes	1000 T
Expiration fix	€0,5

The payment margin for a Future day instrument series is calculated using expiration fix:

Long position:

$$Payment\ margin(NCD3009-13) = -(€\ 0{,}5 \times 10\ lots \times 1000\ T) = € - 5000$$

Short position:

$$Payment\ margin(NCD3009-13) = -(€\ 0{,}5 \times -10\ lots \times 1000\ T) = €5000$$

Appendix F - **Natural Gas Markets**

This appendix illustrates the margining of natural gas derivatives contracts cleared at Nasdaq Clearing. Table 54 below presents an overview of the natural gas market:

Table 54: *Natural gas market overview*

Geographical area	Product	Contract length	Instrument currency
UK	Monthly DSF	Day, weekend, working day week, balance of the working day week, month, balance of the month, front month, back month, quarter, season, year	GBP pence
Belgium	Monthly DSF	Day, weekend, working day week, month, quarter, season, year	GBP pence
Netherlands	Monthly DSF	Day, weekend, working day week, balance of the working day week, month, balance of the month, quarter, season, year	EUR
Germany	Monthly DSF	Day, weekend, working day week, balance of the working day week, balance of the month, quarter, season, year	EUR
France	Monthly DSF	Day, weekend, working day week, month, quarter, season, year	EUR

4.9 Contingent Variation Margin calculation

The Contingent Variation Margin (CVM) is calculated for Natural Gas Monthly Deferred Settlement Future (Monthly DSF) in the trading and delivery period. In the delivery period, CVM is calculated for the not yet settled part of the contract.

Example: Calculation of Contingent Variation Margin in the delivery period, with currency conversion

Product	Futures
Instrument series	NBPM_MOCT-13
Position	15
Therms	16 000 Th
Expiration fix	50 p/Th
# of trades	1
EURGBP (incl. hair-cut)	1,123456
Margin currency	GBP

A starting point in the calculation of Contingent Variation Margin in the delivery period is the estimation of a theoretical Daily Fix. For this purpose the Daily Fixes of underlying instrument series are obtained. For the instrument series in question, the following underlying instrument series and Daily Fixes are available:

Table 55: Overview of underlying product series and fixes

Product series	Volume left	Fix
NBPM_W42-13	5000 Th	50 p/Th
NBPM_W43-13	7000 Th	45 p/Th
NBPM_W44-13	4000 Th	47 p/Th

The Theoretical Daily Fix is calculated as follows (see Formula):

$$\mathrm{TDP(NBPM\_MOCT-13)} = \frac{50\ \mathrm{p/TH} \times 5000\mathrm{TH} + 45\mathrm{p/TH} \times 7000\mathrm{TH} + 47\mathrm{p/TH} \times 4000\mathrm{TH}}{16\ 000\mathrm{TH}} = 47{,}06\mathrm{p/TH}$$

Having estimated a theoretical Daily Fix, the Contingent Variation Margin for the DS Futures NBPM_MOCT-13 can be obtained using Formula. As natural gas contracts are quoted in pence, a price quotation multiplier of 0,01 is used to convert the result into GBP. Having accounted for currency conversion, the CVM for NBPM_MOCT-13 is calculated:

$$\mathrm{CVM(NBPM\_MOCT-13)} = (47{,}06\mathrm{p/TH} - \mathrm{p}50/\mathrm{TH}) \times 15 \times 16\ 000\mathrm{T} \times 0{,}01 \times \mathrm{EURGBP}\ 1{,}123456 = £ - 7920$$

4.10 Initial Margin calculation

The initial margin of a natural gas DS Futures is calculated in both the trading and the delivery period. If the margin currency is different from the instrument currency, the Initial Margin is converted at the applicable exchange rate. Examples below illustrate the step by step calculation of Initial Margin.

4.10.1 Estimating risk interval in % and currency

Example: Calculation of Risk Interval in % and currency (scanning range)

Product	Futures
Instrument series	NBPM_W47-13
Delivery period	18-24.11.2013
Days to start of delivery	34 d
Days to stop of delivery	41 d
Daily fix	55p

In order to estimate a risk interval for the delivery period in question, the principles described in section “Calculation of the Risk Interval” shall be applied. A starting point is to obtain a volatility matrix for the market in question:

Table 56: Example of volatility table for the UK natural gas market

Days to start and stop of delivery	Risk interval
1	25%
8	25%
15	20%
22	17%
29	15%
36	10%

43	10%

The Risk Interval for a delivery period where the middle of the delivery period is between two observations is calculated as follows: for a delivery period with 33 days to start of delivery and delivery ending at day 40, SPAN® has the following approach: 2/7 of the period derives from the “29 days to delivery” observations and 4/7 from “36 days to delivery”. This results in the following risk interval in %:

$$\mathrm{RI(NBPM\_W47-13)} = \frac{2}{7} \times 15{,}00\% + \frac{5}{7} \times 10{,}00\% = 4{,}29\% + 7{,}14\% = 11{,}43\%$$

The Risk Interval in the instrument series currency is:

$$\mathrm{RI(NBPM\_W47-13)} = 11{,}43\% \times 55\mathrm{p} = 6{,}29\mathrm{p}$$

4.10.2 Calculating the risk array

Example: Risk Array calculation

Product	Futures
Instrument series	NBPM_SW-14
Delivery period	01.10.2014-31.03.2015
Scanning range	6,95p
Daily fix	69,45p

Table 57: *Example of Risk Array calculation for DS Futures*

Scenario	Theoretical price scenario NBPM_SW-14	Implied volatility	Theoretical value change NGUKBLSW-14
1	69,45	-	0
2		-	
3	71,77	-	2,32
4		-	
5	67,13	-	-2,32
6		-	
7	74,08	-	4,63
8		-	
9	64,82	-	-4,63
10		-	
11	76,4	-	6,95
12		-	
13	62,5	-	-6,95
14		-	
15	90,3	-	6,25*
16	48,6	-	-6,25*

**theoretical value changes in extreme scenarios are weighted with a factor 0,3 (+/-20,84 x0,3)*

4.10.3 Calculating naked initial margin

When scanning range and risk scenarios are estimated, the scenario generating the greatest potential loss shall be chosen to calculate a Naked Initial Margin. If contract currency is different from margin currency, the naked initial margin is converted using the applicable exchange rate.

Example: Naked initial margin calculation in the trading period

Product	Futures
Instrument series	NBPM_MOCT-16
Position	-15
Therms	14 000 Th
Worst risk array value	8,51p
EURGBP (incl. hair-cut)	1,123456
Margin currency	EUR

The naked initial margin calculation in the delivery period is performed in the same way as in the trading period. In the case of currency conversion, the worst case scenario is multiplied with the exchange rate with applicable hair-cut between the instrument series currency and margin currency and rounded to two decimals afterwards (see Appendix B). The converted naked initial margin for the DSF contract NBPM_MOCT-16 is:

$$\text{IM}_{\text{naked}}(\text{NBPM}_{\text{MOCT}} - 16) = -15 \times 14\,000\text{TH} \times \text{Round}(8{,}51\text{p} \times 0{,}01 \times \text{EURGBP}\ 1{,}123456; 2) = £ -\ 21\,00$$

4.10.4 Position netting within a delivery period

To calculate a Required Initial Margin, the instrument series in the portfolio are divided into time spread periods which are covered by the shortest listed contracts. For opposite positions of instrument series in the same Risk Group, covering the same delivery period, the initial margin is be netted to calculate the risk of the remaining position, as described in section “Position Netting within a Delivery Period”.

Example: Position netting within a delivery period

Table 58: *Portfolio of DS Futures contracts*

Instrument series	Position	Therms, Th	Volume, Th	Delivery period	SR, p
NBPM_Q4-14	10	92000	920000	01.10-31.12.2014	9,27
NBPM_SW-14	-5	182000	-910000	01.10.2014-31.03.2015	8,24

Assuming that the smallest tradable instrument series are quarter instrument series, the instrument series in a portfolio shall be subdivided into time spread periods covered by quarter series. The series in question have an overlapping time spread period in Quarter 4. The net position for the time spread period 01.10-31.12.2014 will thus be 5 long.

Table 59: Time Spread Periods

Time spread period	Instrument series	Net Position	Therms, Th
01.10-31.12.2014	NBPM_Q4-14	5	92000
01.01-31.03.2015	NBPM_SW-14	-5	90000

In order to estimate the risk on a net position, SPAN® will combine 16 risk scenarios of two instrument series and define the worst combination of scenarios for the Time Spread Periods in question (see section "Position Netting within a Delivery Period).

Table 60: Initial margin netting within a delivery period

	Position	Volume, (Th)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
01.10-31.12.2014 (NBPM_Q4-14)	10	92 000	-25 863	**-28 737**	-19 158	-9 579	0	9 579	19 158	28 737	25 863
01.01-31.03.2015 (NBPM_SW-14)	-5	92 000	11 495	**12 772**	8 510	4 263	0	-4 263	-8 510	-12 772	-11 495
Net	**5**		-14 369	**-15 965**	-10 649	-5 317	0	5 317	10 649	15 965	14 369
Initial margin "Worst case" (-3/3)				**-15 965**							
Initial margin rest position											
01.01-31.03.2015	-5	90 000	33 372	37 080	24 705	12 375	0	-12 375	-24 705	**-37 080**	-33 372
Sum required initial margin				-53 045							
Naked initial margin				-78 589							
Effect of netting				-25 544							

The calculation of risk scenarios is performed according to the sections "Risk Array Calculations" and "Naked Initial Margin" (using NBPM_Q4-14, scenario -3/3 as an example):

$$\text{Value change}(01.10-31.12.2014)_{\text{NBPM\_Q4-14; }-3/3} = 10 \times 92\,000\text{TH} \times (\text{Round}(9{,}27\text{p} \times -3/3); 2) \times 0{,}01$$
$$= £-28\,737$$

A combination of risk scenarios -3/3 for both instrument series gives the worst case loss for the portfolio in question. Naked initial margin is calculated for the rest position.

4.10.5 Time spread credit

The next step in the initial margin calculation is the assessment of Time Spread Credit. Time Spread Credit is applied between different Time Spread Periods with opposite exposure within the same Risk Group. The degree of crediting is dependent on the correlation level between Time Spread Periods (see section "Time Spread Credit due to Correlation"). If the instrument currency is different from the margin currency, Risk Array scenarios are converted at the applicable exchange rates.

Example4: Time Spread Credit between Time Spread Periods

Table 61: Portfolio of DSFs

Contract	Position	Therms, T	Volume, T	Instrument currency	Margin currency	Time spread period	Corr.
NBPM_MJUL-14	8	31000	248000	GBP pence	EUR	01-31.07.2014	0,97
NBPM_MAUG-14	-3	31000	-93000	GBP pence		01-31.08.2014	

Instrument currency	GBP pence
Margin currency	EUR
EURGBP high	1,312546
EURGBP low	1,187516

For the contracts in question, SPAN® uses the following theoretical value changes in 16 scenarios (in instrument currency):

Table 62: *Theoretical value changes of Futures*

Scenario	Theoretical value change NBPM_MJUL-14	Theoretical value change NBPM_MAUG-14
1	0	0
2		
3	4,3	2,49
4		
5	-4,3	-2,49
6		
7	8,59	4,98
8		
9	-8,59	-4,98
10		
11	12,89	7,47
12		
13	-12,89	-7,47
14		
15	11,6	6,72
16	-11,6	-6,72

The following results are received when entering these values into the calculation of theoretical value changes per position and delivery interval, and accounting for a price quotation multiplier and exchange rate:

Table 63: *Theoretical value changes for NBPM_MJUL-14*

Time spread period	Position	Volume (Th)	Exchange rate, high/low	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
01-31.07.2014	8	248 000	1,312546	-37 765	**-41 962**	-27 950	-13 987	0	13 987	27 950	41 962	37 765
NBPM_MJUL-14			1,187516	-34 164	-37 969	-25 296	-12 673	0	12 673	25 296	37 969	34 164

Table 64: *Theoretical value changes for NBPM_MAUG-14*

Time spread period	Position	Volume (Th)	Exchange rate, high/low	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
01-31.08.2014	-3	-93 000	1,312546	8 205	9 114	6 082	3 041	0	-3 041	-6 082	**-9 114**	-8 205
NBPM_MAUG-14			1,187516	7 424	8 249	5 496	2 753	0	-2 753	-5 496	-8 249	-7 424

The calculation of risk scenarios is done according to section “Risk Array Calculations” and “Naked Initial Margin” (using -3/3 scenario with high exchange rate as an example):

$$\text{Value change}(01-31.07.2014)_{\text{NBPM\_MJUL}-14;-3/3;\,\text{high}}$$
$$= 8 \times 31\ 000\text{TH} \times \text{Round}(12{,}89\text{p} \times \text{EURGBP}1{,}312546; 2) \times 0{,}01 = € - 41\ 962$$

$$\text{Value change}(01-31.08.2014)_{\text{NBPM\_MAUG}-14;\,-3/3;\text{high}}$$
$$= -3 \times 31\ 000\text{TH} \times \text{Round}(7{,}47\text{p} \times \text{EURGBP}1{,}312546; 2) \times 0{,}01 = € - 9114$$

The worst case scenarios for NBPM_MJUL-14 and NBPM_MAUG-14 are the scenarios -3/3 and +3/3 (high exchange rate) respectively.

The time spread periods in question demonstrate a correlation of 0,90 and have opposite exposure which allow for a time spread credit. The volume credited in time spread is maximized to the smallest volume available in the Time Spread Periods. Having adjusted theoretical values for the time spread delta, the following results are calculated for the portfolio in question:

Table 65: *Time Spread Credit between Time Spread Periods*

Time spread periods	Instrument series	Volume (Th)	Exchange rate, high/low	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
01-31.07.2014	NBPM_MJUL-14	93 000	1,312546	-14 162	**-15 736**	-10 481	-5 245	0	5 245	10 481	15 736	14 162
			1,187516	-12 812	-14 238	-9 486	-4 752	0	4 752	9 486	14 238	12 812
01-31.08.2014	NBPM_MAUG-14	-93 000	1,312546	8 205	9 114	**6 082**	3 041	0	-3 041	-6 082	-9 114	-8 205
			1,187516	7 424	8 249	5 496	2 753	0	-2 753	-5 496	-8 249	-7 424
Net (1 step)				-5 957	**-9 653**	-7 440	-5 245	-3 041	-837	1 367	6 622	5 957
				-5 387	-8 742	-6 733	-4 752	-2 753	-744	1 237	5 989	5 387
Initial margin "worst case" (-3/3&-2/3)						**-9 653**						
Initial margin rest volume												
01-31.07.2014		155 000	1,312546	-23 603	**-26 226**	-17 469	-8 742	0	8 742	17 469	26 226	23 603
			1,187516	-21 353	-23 731	-15 810	-7 921	0	7 921	15 810	23 731	21 353
Sum required initial margin						-35 879						
Naked initial margin						-51 076						
Effect of time spread netting						-15 196						

The calculations of scenarios are performed in the following way (using data from Table 63, 64 and 65 and scenario -3/3 as an example):

$$\text{Value change}(01-31.07.2014)_{\text{NBPM\_MJUL}-14;-3/3;\text{high}} = \frac{€ - 41\ 962}{248\ 000\ \text{TH}} \times 93\ 000\ \text{TH} = € - 15\ 736$$

$$\text{Value change}(01-31.08.2014)_{\text{NBPM\_MAUG}-14;-3/3;\text{high}} = \frac{€9114}{-93\ 000\ \text{TH}} \times -93\ 000\text{TH} = €9114$$

As correlation is 0,97, the worst case for the combination of scenarios is examined within one step (see section "Determining the Worst Case Scenario"). Scenarios calculated at a high (low) exchange rate for one time spread period are compared with scenarios at high (low) exchange rate for another time spread period. For the instrument series in question, the worst combination will be for scenarios -3/3 and -2/3 (exchange rate high).

4.10.6 Inter commodity spread credit

The last stage of the calculation of Required Initial Margin is the calculation of Inter Commodity Spread Credit (ICSC). ICSC is based on the correlation between different markets (different Risk Groups), after all netting effects within the Risk Group. The methodology of Inter Commodity Spread Credit is available in the section "Inter Commodity Spread Credit".

Example: Inter Commodity Spread Credit calculation

Table 66: *Portfolio of Futures contracts*

Time spread periods	Contract	Position	Therms/Hours	Volume, Th/MWh	SR, £	Naked IM, £
01.01-31.03.2014	NBPM_Q1-14	-5	90000	-450000	0,07	-31500
01.01-31.03.2014	EUKMBQ1-14	10	2159	21590	5,49	-118529

In order to be able to calculate inter commodity spread credit between two Time Spread Periods, tiers of contracts covering the periods, delta ratios between tiers and credit spread have to be identified. The following information is available for the periods in question:

Table 67*: ICSC variables*

Leg A:	NBPM_Q1-14	
Leg B:	EUKMBQ1-14	
Contract spread	**Delta ratio**	**Credit spread**
Leg A : Leg B	1000:15	50 %

The delta ratios determine the volume per Time Spread Period Participating in the ICSC. Using data from table 66 and 67, the ICSC delta can be determined (period of 01.01-31.03.2014 as an example):

$$\text{ICSC delta}(01.01 - 31.03.2014)_{\text{NBPM\_Q1-14}} = \frac{-450\ 000\ \text{TH}}{1000} = -450\ \text{TH}$$

After ICSC deltas are calculated for both Time Spread Periods, the absolute minimum delta is chosen. The absolute minimum delta determines the volume on which credit will be calculated. The credit in £ is obtained as follows (period of 01.01-31.03.2014 as an example and using data from tables 55 and 56):

$$\text{Credit}(01.01 - 31.03.2014)_{\text{NBPM\_Q1-14}} = \text{ABS}\left(-\frac{450\ \text{TH}}{450\ \text{TH}} \times £ - 31\ 500 \times 0{,}50\right) = £15\ 750$$

Table 68 summarizes the calculation of ICSC for both Time Spread Periods and demonstrates the overall reduction in the initial margin:

Table 68: *ICSC calculations*

Time spread periods	Product	Naked IM, £	Delta ratios	Original delta, Th/MWh	ICSC Delta, Th/MWh	ABS Delta, Th/MWh	Min Delta, Th/MWh	Credit spread, %	Credit, £
01.01-31.03.2014	NBPM_Q1-14	-31 500	1000	-450 000	-450	450	450	50,00 %	15 750
01.01-31.03.2014	EUKMBQ1-14	-118 529	15	21 590	1 439	1 439	450	50,00 %	18 529

Instrument series	Naked IM, £	Required IM, £	Effect of ICSC, £
NBPM_Q1-14	-31 500	-15 750	-15 750
EUKMBQ1-14	-118 529	-100 000	-18 529
Sum	**-150 029**	**-115 750**	**-34 279**

Appendix G - **SEAFOOD MARKETS**

This appendix illustrates a margining of Seafood instrument series cleared at Nasdaq Clearing. An overview of existing Seafood markets is available below in Table 69:

***Table 69**: Seafood markets cleared at NASDAQ Clearing*

Underlying	Product	Instrument series length	Instrument currency
Fish Pool Index (FPI)	Futures, Asian options (Delivery Period 2013 and 2014)	Month, Quarter, Year	NOK
Fish Pool Salmon Price(FPSA15)	Futures, Asian options (Delivery Period 2015 and onwards)	Month, Quarter, Year	NOK

4.11 Contingent Variation Margin calculation

The Contingent Variation Margin is calculated as the Market Value is calculated for the option instrument series until it is exercised. Futures Variation Margin is present in the intra-day Margin Requirement calculations to reflect the risk of mark-to-market settlement (see section “Market Valuation”).

Example: Calculation of Option Market Value in the trading period

Product : Asian Option on future

Instrument series : FPSA JUL14 C32.50

Position : -10 lots

Lot Size : 1000 kg

Trade Price : NOK 5/kg

Daily Fix : NOK 5.76/kg

Margin currency : NOK

The market value for the Option instrument series in question is obtained by using Formula:

$$\text{MV(FPSA JUL14 C32.50)} = \text{NOK } 5.76/\text{kg} \times -10 \text{ lots} \times 1\,000 \text{ kg} = \text{NOK} - 57\,600$$

4.12 Initial Margin calculation

The Initial Margin is calculated for Futures and Asian Options until they are exercised. The Initial Margin is a part of both intra-day and end-of-day margin requirement. If the Margin Currency is different from the Instrument Currency, the Initial Margin is converted at the applicable exchange rate.

The examples below illustrate step by step calculation of Initial Margin.

4.12.1 Estimating Risk Interval in % and currency

Example: Calculation of Risk Interval in % and currency (scanning range)

Product : Future

Instrument series : FPSA NOV13

Delivery period : 02.11.2013 – 29.11.2013

Days to start of delivery : 38 days

Days to stop of delivery : 65 days

Daily Fix : NOK 35,80/kg

In order estimate a Risk Interval for the delivery period in question, the principles described in section "Calculation of the Risk Interval" shall be applied. A starting point is to obtain a volatility table for the market in question:

Table 70: *Example of volatility table for the Seafood market*

Days to start and stop of delivery	Risk interval
-6	13 %
29	13%
57	10%
85	9%

The Risk Interval for a delivery period where the middle of the delivery period is between two observations is calculated as follows: for a delivery period with 38 days to start of delivery and delivery ending at day 65, SPAN® has the following approach: 9/28 of the period derives from the "57 days to delivery" observations and 19/28 from "29 days to delivery". This results in the following Risk Interval in %:

$$\mathrm{RI(FPSA\ NOV13)} = \frac{9}{28} \times 10\% + \frac{19}{28} \times 13\% = 3{,}21\% + 8{,}82\% = 12{,}03\%$$

Risk Interval in the instrument series currency is:

$$\mathrm{RI(FPSA\ NOV13)} = 12{,}03\% \times \mathrm{NOK}\ 35{,}80 = \mathrm{NOK}\ 4{,}31$$

4.12.2 Calculating the Risk Array

Example: Risk Array calculation

Product : Future

Instrument series : FPSA NOV13

Delivery period : 02.11.2013 – 29.11.2013

Scanning range : NOK 4,31/kg

Daily Fix: NOK 35,80/kg

As described in the section “Risk Array Calculation”, the next step in the calculation of Initial Margin is the estimation of risk scenarios. Based on the data above, the following risk scenarios are available for FPSA NOV13:

***Table 71:** Example of Risk Array calculation for Seafood future*

Scenario	Theoretical price scenario	Implied volatility	Theoretical value change FPSA NOV13
1	35,80	-	0
2		-	
3	37,24	-	1,44
4		-	
5	34,36	-	-1,44
6		-	
7	38,67	-	2,87
8		-	
9	32,93	-	-2,87
10		-	
11	40,11	-	4,31
12		-	
13	31,49	-	-4,31
14		-	
15	48,72	-	3,88*
16	22,88	-	-3,88*

*theoretical value changes in extreme scenarios are weighted with a factor 0,3 (+/-12,92 x0,3)

Example5: Risk array calculation

Product: Asian Option

Instrument series: FPSA JUL14 C32.50

Underlying Instrument series: FPSA JUL14

Delivery period of underlying Future: 28.06.2014 – 01.08.2014

Scanning range: NOK 2,64 /kg

Daily Fix for underlying Future: NOK 37,70/kg

Implied volatility: 20 %

In the estimation of a Risk Array for option instrument series, the implied volatility shall be considered. Theoretical values and value changes are calculated for seven different prices of the underlying derivative implemented under two volatility levels (up and down) and two extreme price scenarios of the underlying derivative that exceed the scanning range (volatility unchanged). Inserting the available variables into the Turnbull & Wakeman approximation model (see section “Risk Array Calculations”), the following risk scenarios are obtained for the instrument series in question:

Table 72: *Example of Risk Array calculation for Option*

Scenario	Theoretical price scenario for underlying Future	Implied volatility (+30%, -30%)	Theoretical value FPSA JUL14 C32.50	Theoretical value change FPSA JUL14 C32.50
1	37,70	0,26	6,32	0,56
2		0,14	5,31	-0,45
3	38,58	0,26	6,99	1,23
4		0,14	6,09	0,33
5	36,82	0,26	5,67	-0,09
6		0,14	4,56	-1,20
7	39,46	0,26	7,69	1,93
8		0,14	6,90	1,14
9	35,94	0,26	5,04	-0,72
10		0,14	3,85	-1,91
11	40,34	0,26	8,42	2,66
12		0,14	7,72	1,96
13	35,06	0,26	4,45	-1,31
14		0,14	3,18	-2,58
15	45,62	0,20	12,85	2,13*
16	29,78	0,20	1,09	-1,40*

*theoretical value changes in extreme scenarios are weighted with a factor 0,3 (7,09 x0,3 in scenario 15 and -4,67x0,3 in scenario 16)

4.12.3 Calculating Naked Initial Margin

After scanning range and risk scenarios are estimated, the scenario generating the greatest potential loss shall be chosen to calculate a Naked Initial Margin.

Example: Naked Initial Margin

Product : Future

Instrument series : FPSA NOV13

Delivery period : 02.11.2013 – 29.11.2013

Position : +10 lots

Lot size : 1000 kg

Risk array : See table 72

For the instrument series in question, the worst case scenario will be scenario 13 – a price decrease by 3/3 of the scanning range. Applying Formula 6, the Naked Initial Margin for the Future FPSA NOV13 is:

$$IM_{naked}(FPSA\ NOV13) = 10\ lots \times 1000 \frac{kg}{lot} \times NOK - 4{,}31 = NOK - 43\ 100$$

4.12.4 Time Spread Credit due to Correlation

The next step in the Initial Margin calculation is the assessment of Time Spread credit. Time Spread Credit is applied between different Time Spread Periods with opposite exposure within the same Risk

Group. A degree of crediting is dependent on the correlation level between Time Spread Periods (see section “Time Spread Credit due to Correlation”).

Example: Time spread netting between time spread delivery periods

Table 73: *Portfolio of Future and Option instrument series*

Instrument series	Position, lots	Lot size(kg)	Volume, kg	Time Periods	Spread	Composite delta	Correlation
FPSA NOV13	-10	1000	-10000	02.11-29.11.2013		N/A	
FPSA JUL14 C32.50	10	1000	10000	28.06-01.08.2014		0,30	0,97

For the instrument series in question, SPAN® presents the following theoretical value changes in 16 scenarios:

Table 74: *Theoretical value changes of Future and Asian Option*

Scenario	Theoretical value change FPSA NOV13	Theoretical value change FPSA JUL14 C32.50
1	0	0,56
2		-0,45
3	1,44	1,23
4		0,33
5	-1,44	-0,09
6		-1,20
7	2,87	1,93
8		1,14
9	-2,87	-0,72
10		-1,91
11	4,31	2,66
12		1,96
13	-4,31	-1,31
14		-2,58
15	3,88	2,13
16	-3,88	-1,40

The following results are received when entering these values into the calculation of theoretical value changes per position and Time Spread Periods:

Table 75*: Theoretical value changes for Asian Option position*

Time spread period	Position (lots)	Volume (kg)	Implied volatlity	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
28.06-01.08.2014	10	1000	Up	-14000	-13100	- 7200	- 900	5600	12300	19300	26600	21300
FPSA JUL14 C32.50			Down	-14000	**-25800**	-19100	-12000	-4500	3300	11400	19600	21300

__Table 76:__ Theoretical value changes for Future position

Time spread period	Position (lots)	Volume (kg)	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
02.11-29.11.2013	-10	-1000	38000	43100	28700	14400	0	-14400	-28700	**-43100**	-388008

The calculation of risk scenarios is done according to section "Risk Array Calculations" and "Naked Initial Margin" (using 3/3 scenario as an example):

$$\text{Value change}(28.06 - 01.08.2014)_{\text{FPSA JUL14 C32.50;3/3; up}} = 10 \times 1000\text{ kg} \times \text{NOK}2.66 = \text{NOK } 26\,600$$

$$\text{Value change}(02.11 - 29.11.2013)_{\text{FPSA NOV13; 3/3}} = -10 \times 1000\text{ kg} \times \text{NOK } 4{,}31 = \text{NOK} - 43\,100$$

The worst case scenarios for FPSA JUL14 C32.50 and FPSA NOV13 are the scenarios -3/3 (volatility down) and +3/3 respectively.

The Time Spread Periods in question demonstrate a correlation of 0,97 and have opposite exposure which allow for a Time Spread Credit. Options' contribution to time spread is dependent on a composite delta. For the Option in question, delta/volume used in time spread is:

$$\text{Delta}(28.06 - 01.08.2014)_{\text{FPSA JUL14 C32.50}} = 10 \times 1000\text{kg } \times 0{,}2977 = 2977\text{ kg}$$

The volume credited in time spread is maximized to the smallest amount available in the Time Spread Periods. Having adjusted the theoretical values for the time spread delta, the following results are calculated for the portfolio in question:

__Table 77:__ Time Spread Credit between different Time Spread Periods

Time spread periods	Contracts	Volume (kg)	Implied volatlity	-Ext	-3/3	-2/3	-1/3	0	+1/3	+2/3	+3/3	+Ext
28.06-01.08.2014	FPSA JUL14 C32.50	2977	Up	-14000	-13100	-7200	-900	5600	12300	19300	26600	21300
			Down	-14000	**-25800**	-19100	-12000	-4500	3300	11400	19600	21300
02.11-29.11.2013	FPSA NOV13	-2977		11312	12831	**8543**	4287	0	-4 287	-8543	-12831	-11312
Net (1 step)				-2688	-4557	-2913	-900	1313	3757	6469	13769	9988
				-2688	**-17257**	-14813	-12000	-8787	-5243	-1431	6769	9988
Initial margin "worst case" (-3/3&-2/3)				**-17257**								
Initial margin rest volume												
02.11-29.11.2013		-7023		26687	30269	20156	10113	0	-10113	-20156	**-30269**	-26687
Sum required initial margin				-47256								
Naked initial margin				-68900								
Effect of time spread netting				-21374								

The calculations of scenarios are performed in the following way (using data from Table 75, 76 and 78 and scenario +3/3 as an example):

$$\text{Value change}(28.06 - 01.08.2014)_{\text{FPSA JUL14 C32.50;3/3; up}} = \text{NOK } 26600 \times \frac{2977}{2977} = \text{NOK } 26600$$

$$\text{Value change}(02.11 - 29.11.2013)_{\text{FPSA NOV13; 3/3}} = \text{ NOK} - 43100 \ \times 2977/10000 = \ \text{NOK} - 12831$$

As correlation is 0,97, the worst case for the combination of scenarios is examined within one step (see section "Determining the Worst Case Scenario"). For the instrument series in question, the worst combination will be for scenarios -2/3 and -3/3 (volatility down).