# ETP INITIAL MARGIN

## Methodology Document

February 2018

## INTRODUCTION

Initial margin (IM) represents the only prefunded line of defense available to mitigate the risks associated with a participant defaulting on the bond ETP. IM is calculated at an individual primary dealer (PD) level, and the IM posted against the exposures of a particular PD can only be used to satisfy the losses incurred in unwinding the unsettled positions of said PD, in the event of default. The aim of this document is to clearly specify the methodology used by the JSE, who calculates the IM requirements for each PD on the ETP on a daily basis.

## OVERVIEW

The exposure that a particular PD presents to the ETP market on a particular day can be depicted as a function of the Mark-to-Market ($\mathrm{MtM}$) and Potential Future Exposure ($\mathrm{PFE}$) of the particular PD:

$$\mathrm{Exposure} = \mathrm{MtM} + \mathrm{PFE},$$

where $\mathrm{MtM}$ represents the particular PDs liquidation gains/losses relative to current market prices, whilst $\mathrm{PFE}$ represents the potential liquidation gains/losses that could still be incurred as a result of unwinding defaulting positions at a future point in time.

It is important to note that a variation margin (VM) construct does not exist for the ETP market. Under typical CCP models, VM is used on a daily basis to set the MtM exposure to each participant equal to zero – with IM being a pure PFE measure. As such, it is important for the IM applied in the ETP market to consider each participant's MtM and PFE. Accordingly, the IM requirement for a particular PD on a particular PD will be calculated as follows:

$$\mathrm{IM} = \mathrm{MtM} + \mathrm{PFE}. \tag{1}$$

## THE MTM CALCULATION

On an arbitrary IM calculation date, $t_0$, the $\mathrm{MtM}$ calculation for a particular PD is as follows:

$$\mathrm{MtM} = \sum_{i=1}^{n}\sum_{j=1}^{m} C^{i,j}\left[\mathrm{P}^{i,j} - \mathbb{P}^{i}\right], \tag{2}$$

where:

- $n$ represents the number of bonds available on the ETP market;
- $m$ represents the number of unsettled trades in bond $i$;
- $\mathrm{P}^{i,j}$ represents the price, expressed per R1 nominal, at which the $j^{th}$ trade in the $i^{th}$ bond was executed;
- $\mathbb{P}^{i}$ represents the JSE's official closing price for the $i^{th}$ bond on $t_0$; and
- $C^{i,j}$ represents the nominal value associated with the $j^{th}$ trade in the $i^{th}$ bond.

**THE PFE CALCULATION**

The PFE calculation consists of two distinct components:

- A component which estimates, within a certain confidence level, the extent to which the MtM exposure of a particular PD could change over an assumed liquidation period. Henceforth this component will be referred to as $\mathrm{PFE}^{\mathrm{mid}}$; and
- A component which estimates the losses that could be incurred as a result of closing/unwinding positions away from mid-market rates (i.e. the impact of a bid/ask spread). Henceforth this component will be referred to as $\mathrm{PFE}^{\mathrm{double}}$

It follows that:

$$\mathrm{PFE} = \mathrm{PFE}^{\mathrm{mid}} + \mathrm{PFE}^{\mathrm{double}} \tag{3}$$

**THE $\mathrm{PFE}^{\mathrm{MID}}$ CALCULATION**

The $\mathrm{PFE}^{\mathrm{mid}}$ measure is estimated through the use of a historical Value-at-Risk (VaR) framework supplemented with a series of stress scenarios - specifically designed to mitigate the risk associated with a break-down in historically observed correlation patterns.

The algorithm underlying $\mathrm{PFE}^{\mathrm{mid}}$ calculation is as follows:

1. For each bond on the ETP market, create a profit and loss vector, PnL , with each element representing the PnL associated with R1 long position in the particular bond, under a particular curve shift scenario;
2. Calculate the net position level profit and loss vector for a particular PD by multiplying said PDs net unsettled position in each bond by the relevant PnL vector;
3. Calculate the portfolio level PnL vector for the particular PD by adding all of the position level PnL vectors calculated in step 2; and finally
4. Estimate $\mathrm{PFE}^{\mathrm{mid}}$ as the element in the portfolio level PnL vector which would result in the worst loss (negative PnL move) for the particular PD.

A summary of the applied VaR mode is provided in Table 1 below.

| | |
|---|---|
| Model description | VaR with full revaluation. |
| Scenario types | Historical scenarios supplemented with a set of prospective what-if scenarios[1]. |
| Curves used | JSE Zero Coupon bond curve. |
| Type of curve shifts applied | Absolute curve shifts. |
| Volatility scaling applied (Y/N) | No |
| Parameter recalibration frequency | Bond level PnL vectors recalibrated every two weeks. |

[1] See Appendix A for an in depth description of the calibration framework underlying these scenarios.

| | |
|---|---|
| Look-Back period used for historical scenarios | Rolling 3-year period supplemented with the most extreme 1-year stressed period observed during the past 30 years[2]. |
| Current stressed period | 18-July-2001 to 17-July2002 |
| Stressed period review frequency | Annual |
| Liquidation period | 3-days |
| Confidence level | Worst case scenario. |
| Position netting | A single net unsettled position across all settlement dates is calculated per bond. |

*Table 1: Parameters underlying the $PFE^{mid}$ calculation.*

**THE $\mathrm{PFE}^{\mathrm{DOUBLE}}$ CALCULATION**

The $\mathrm{PFE}^{\mathrm{double}}$ measure is estimate through the use of a market survey whereby market participants are requested to indicated the bid/ask spreads typically associated with positions in various sizes. More specifically, each participant is asked to provide an estimate of the bid/ask spread that would be applicable when executing a trade in a particular bond, for a series of potential trade sizes (measured in terms of PV01), under stressed market conditions.

| Bond/PV01 | $[-\infty; -1m)$ | $[-1m; -0.5m)$ | $[-0.5m; 0)$ | $[0; 0.5m)$ | $[0.5m; 1m)$ | $[1m; \infty)$ |
|---|---|---|---|---|---|---|
| R186 | 20 | 10 | 4 | 4 | 10 | 20 |
| R209 | 30 | 15 | 8 | 8 | 15 | 30 |
| R213 | 30 | 15 | 8 | 8 | 15 | 30 |
| R214 | 40 | 20 | 10 | 10 | 20 | 40 |

*Table 2: Example of the market polling survey used to calibrate $PFE^{double}$.*

As an example, a value of 10 in the $[-0.5m; 0)$ bucket for the R186 indicates that a bid/ask spread of 4bps would typically be applicable when executing a trade with a PV01 of less than zero but more than –R500k, under stressed market conditions.

Once all feedback has been collated, the JSE calibrates $\theta^i(x)$; a function which estimates the bid/ask spread applicable when executing a position of size $x$ (expressed in terms of PV01) in the $i^{th}$ bond. The calibration is performed by averaging the feedback per PV01 bucket, after removing outliers.

[2] Seen Appendix B for clarification on how the most extreme period is defined.

Once $\theta$ is calibrated, $\mathrm{PFE}^{\mathrm{double}}$ is estimated as follows:

$$\mathrm{PFE}^{\mathrm{double}} = \sum_{i=1}^{n} \frac{1}{2} \mathrm{PV01}^{i} \times \theta^{i}(\mathrm{PV01}^{i}), \quad (4)$$

where:

- $\mathrm{PV01}^{i}$ represents the change in the value of the particular PD's net unsettled position in the $i^{th}$ bond, under a scenario where the entire zero curve moves up in parallel by one basis point.

| | |
|---|---|
| Parameter recalibration frequency | PV01 estimates per bond are recalibrated every two weeks, alongside bond level PnL vectors.<br><br>Market poll to estimate $\theta$ is conducted quarterly. |
| Treatment of outlier in the market polling exercise | Averaging is performed after removing the 2 highest, and 2 lowest contributions per bond, per PV01 bucket. |

*Table 3: Parameters underlying the $PFE^{double}$ calculation.*

**MAINTENANCE LEVELS**

In order to keep the total pool of prefunded default resources as stable as possible, maintenance levels are used whereby PD level IM balances are effectively floored at levels designed to minimize the amount of cash calls that would be required in the absence of such a mechanism. Equation (1) thus changes as follows:

$$\mathrm{IM} = \min(\mathrm{MtM} + \mathrm{PFE}, \text{Maintenance Level}). \quad (5)$$

A tiered approach is followed to determine maintenance levels. In particular:

- A maintenance level of R40 million is set of PDs for whom the 90-day average daily turnover on the ETP market is greater than R300 million;
- A maintenance level of R20 million is set of PDs for whom the 90-day average daily turnover on the ETP market is less than R300 million;

**APPENDIX A: PROSPECTIVE SCENARIOS**

It should be noted that the aim of the prospective scenarios is specifically to mitigate the risk associated with a break-down in historically observed correlation patterns. The aim of these scenarios is not to capture the impact of extreme but plausible parallel shifts in the yield curve, as these should be captured by the historical set of stressed scenarios. Against this backdrop, the prospective scenarios are designed by considering various curve shifts that would be possible, if certain sections of the yield curve were to change independently of one another. The exact logic underlying the selection criteria is discussed below.

Assume that the yield curve can be defined by linearly interpolating the zero coupon rates observed at the following anchor tenors (measured in years): $t = \{\frac{1}{365}; 0.25; 1; 2; 5; 10; 20; 30\}$. Furthermore, assume that over an $n - day$ period, where $n$ denotes the chosen liquidation period for the ETP market, each of the zero coupon rates corresponding to the above anchor points can either move up by 70[3] bps, down by 70 bps, or remain unchanged, and that the change observed in the zero coupon rate corresponding to a particular tenor is independent of that observed for any other tenor. It follows that $3^8 = 6{,}561$ curve shifts are possible over an $n - day$ period:

| Scenario | $t = \frac{1}{365}$ | $t = 0.25$ | $t = 1$ | $t = 2$ | $t = 5$ | $t = 10$ | $t = 20$ | $t = 30$ |
|---|---|---|---|---|---|---|---|---|
| 1 | +70 | +70 | +70 | +70 | +70 | +70 | +70 | +70 |
| 2 | +70 | +70 | +70 | +70 | +70 | +70 | +70 | -70 |
| 3 | +70 | +70 | +70 | +70 | +70 | +70 | +70 | +0 |
| ⋮ | | | | | | | | |
| 6,559 | -70 | -70 | -70 | -70 | -70 | -70 | -70 | +70 |
| 6,560 | -70 | -70 | -70 | -70 | -70 | -70 | -70 | -70 |
| 6,561 | -70 | -70 | -70 | -70 | -70 | -70 | -70 | +0 |

*Table 4: Prospective yield curve shifts scenarios, defined as absolute shifts and to be applied using linear interpolation.*

[3] Chosen by considering the 99.7th percentile change of the $3 - day$ changes that have historically been observed in the individual zero coupon rates. The 99.7th

**APPENDIX B: STRESS PERIOD CALIBRATION**

The historical stressed period to be included in the sample of scenarios used to quantify $\mathrm{PFE}^{\mathrm{mid}}$ is determined by considering the rolling 30-day realized volatility for the benchmark bond, as implied by the prices derived from historically observed zero coupon yield curves. In particular, the stressed period is defined by considering the 12-month window adjacent to the date on which the maximum volatility was observed.

From Figure 1 it can be seen that the maximum 30-day realized volatility for the R186 was observed on 17-January-2002. Accordingly, the stressed period is defined as the period from 18-July-2001 to 17-July2002.

If the stressed period, as defined above, falls within the rolling historical look-back period, the stressed period will be defined as the 12-month window adjacent to the date on which the second largest historical volatility observation was made.

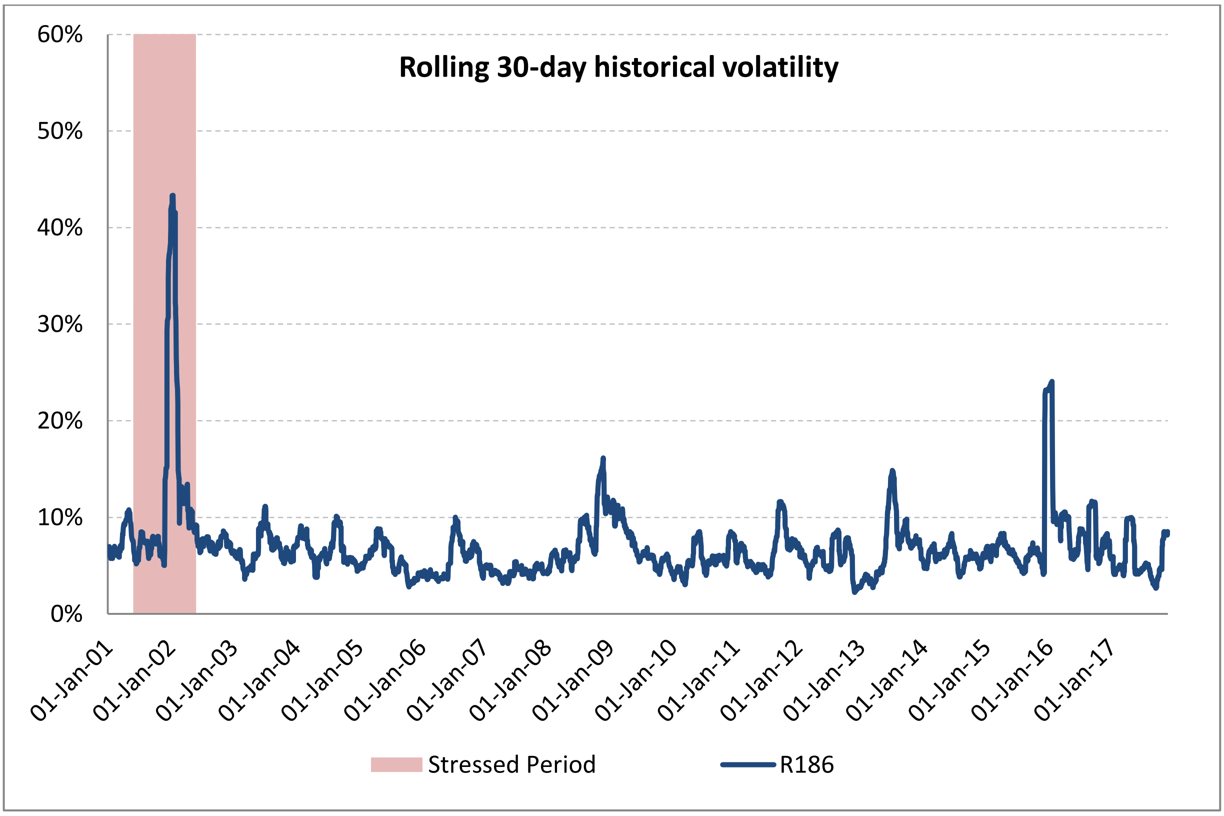


*Figure 1: Justification for the chosen historical stressed period to be used when calculating* $\mathrm{PFE}^{\mathrm{mid}}$.