Prudential Practice Guide

APG 116 – Market risk

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About this guide

Prudential Standard APS 116 Capital Adequacy: Market Risk (APS 116) sets out APRA's requirements of authorised deposit-taking institutions (ADIs) in relation to the management and measurement of market risk (excluding interest rate risk in the banking book, which is covered by *Prudential Standard APS 117 Capital Adequacy: Interest Rate Risk in the Banking Book (Advanced ADIs)* (APS 117)) and the holding of regulatory capital against this risk. This prudential practice guide aims to assist ADIs in complying with those requirements and, more generally, to outline prudent practices in relation to the management and measurement of market risk.

Subject to the requirements of APS 116, ADIs have the flexibility to choose a risk measurement approach appropriate to the complexity of their business and the capacity of their technical resources.

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Overview

1. The following paragraphs provide additional guidance in relation to the 'Overview' section of APS 116.

2. In normal circumstances, it is good practice for an ADI to manage market-related activities and calculate market risk capital charges on a globally consolidated basis. Where these activities are managed independently (e.g. in different centres), APRA may require any market risk capital charges to be measured on a non-consolidated basis.

3. The specific risk component of market risk may be decomposed into:

   (a) idiosyncratic risk – the risk that the price of an individual debt or equity security moves by more or less than the general market in day-to-day trading, including periods when the whole market is volatile; and

   (b) event risk – the risk that the price of an individual debt or equity security moves precipitously relative to the general market (e.g. on a takeover bid or some other shock event); such events would also include the risk of default.

Trading book policy statement

4. Attachment A to APS 116 requires an ADI to have a trading book policy statement.

5. In addition to the minimum requirements set out in that Attachment, it is good practice for an ADI to include in its trading book policy statement the following:

   (a) for the purposes of detailing the activities the ADI considers to be trading and as constituting part of the trading book for capital calculations:

      (i) the criteria used by the ADI in classifying trading positions;

      (ii) a list of the financial instruments to be included within the trading book and the proposed risk measurement methodology to be adopted for each instrument;

      (iii) identification of any instruments specifically excluded from the trading book;

      (iv) whether there are any subsidiaries and/or offshore branches undertaking transactions to be included in the trading book. If so, it is good practice for an ADI to include in its trading book policy statement a list of any such subsidiaries and/or offshore branches, along with a description of the trading activities residing within such entities;

      (v) the operational definition of the trading book to be adopted by the ADI, including a clear description of what treasury transactions are to be classified as trading activities, the treatment of inter-desk deals and the criteria used to identify hedges;

      (vi) the procedures to ensure that the criteria by which items are allocated to the trading or banking books are adhered to on a consistent basis, including, for example, who is responsible for monitoring adherence to the trading book policy statement, the manner and frequency of this monitoring and the confirmation of the continuing appropriateness of allocations;

      (vii) sufficient detail on how positions hedging banking book exposures are to be identified and dealt with where the banking book exposures cease (e.g. if there are swaps hedging a loan portfolio and the loans are repaid early);

(viii) any expected circumstances under which risk and/or instruments may be transferred between the trading and banking books, and the controls in place to ensure that no inappropriate switching of positions between these books occurs;

(ix) clear identification of who is able to approve a transfer between the trading book and the banking book, and the accounting treatment of such transfers; and

(x) specification of a maximum holding period of no more than 180 days for positions to be held in the trading book;

(b) for the purposes of detailing the valuation methodology:

(i) whether mark-to-market accounting is adopted, the sources of rates, whether the most conservative side of the bid-offer spread is used, the treatment of illiquid instruments and policies concerning any reserves or provisions held against mark-to-market profit and loss; and

(ii) a statement to the effect that the valuation methods for capital calculations and the ADI's financial accounts are the same, or an explanation if this is not the case. It is good practice for valuation methods for capital calculations to be the same as for the ADI's financial accounts; and

(c) the ADI's policy regarding dealings in unrated securities and how it complies with the requirements of APS 116. If the ADI considers certain unrated securities to be of investment quality, a statement on how this judgement is made would normally be included.

6. It is good practice for an ADI to have a single document as its trading book policy statement. However, where there is an overlap between what this statement would contain and what is contained in other policy documents and manuals, the ADI may wish to include clear references to the relevant portions of those policy documents and manuals within its statement, rather than repeating such detail in full in the statement.

Interest rate risk

7. Attachment B to APS 116 sets out the requirements that must be met for positions to be included in the correlation trading portfolio. Subject to APRA approval, an ADI may calculate interest rate specific risk for this portfolio as the larger of:

(a) the total specific risk capital charges that would apply just to the net long positions from the net long correlation trading exposures combined; and

(b) the total specific risk capital charges that would apply just to the net short positions from the net short correlation trading exposures combined.

8. In deciding whether to give its approval, APRA will consider whether the ADI:

(a) is conducting a correlation trading business; and

(b) has a robust and appropriately sophisticated framework for the valuation and risk management of positions in its correlation trading portfolio.

9. Attachment B to APS 116 outlines requirements relating to the minimum capital requirement for interest rate risk under the standard method.

10. The duration method, which involves calculating the price sensitivity of each position separately, is a more accurate method than the maturity method but requires additional calculation complexity. Hence, APRA will monitor the systems of an ADI using the duration method.

11. Under the maturity and duration methods, the vertical allowance reflects basis risk and gap risk that arises since each time band may include different instruments and different maturities. The following is an example of the calculation of the vertical disallowance under the maturity method: if the sum of the weighted longs in a time band is $100 million and the sum of the weighted shorts is $90 million, the so-called vertical disallowance for that time band would be 10 per cent of $90 million (i.e. $9.0 million).

12. The general market risk capital requirement under the maturity method can be summarised as the sum of:

Net position	Net short or long weighted positions	× 100%
Vertical disallowances	Matched weighted positions[1] in all maturity bands	× 10%
Horizontal disallowances	Matched weighted positions within zone 1	× 40%
	Matched weighted positions within zone 2	× 30%
	Matched weighted positions within zone 3	× 30%
	Matched weighted positions between zones 1 and 2	× 40%
	Matched weighted positions between zones 2 and 3	× 40%
	Matched weighted positions between zones 1 and 3	× 100%

13. As an example of the treatment of bond futures contracts, a long position in a June three-year government bond future (taken in April) would be reported as a long position in a government security with a maturity of three years and two months and a short position in a government security with a maturity of two months.

14. One pre-processing technique method that an ADI may choose to implement is to convert the cash flows required under each transaction into their present values by discounting using zero-coupon yields. These figures are aggregated so that a single net present value (NPV) is calculated for each time band as specified in the second column of Table 2 in Attachment B to APS 116. To determine price sensitivity, an ADI could then either weight the NPV in each time band by the risk-weights given in Table 2 or use the change in yields given in that table.

15. Table 1 is an example of the treatment of offsetting a future or forward against its underlying, for specific and general market risk. Consider an ADI holding a long position in a government bond maturing in 10 years and three months time and a short position in a 10-year bond futures contract expiring in three months time. The long 10-year bond holding and the short 10-year position arising from the futures contract offset each other, leaving a long position in the one to three months time band that is included.

1 The smaller of the absolute value of the short and long positions within each time band.

Table 1: Summary of treatment of interest rate derivatives		
Instrument	Specific risk[2]	General market risk
Exchange-traded futures		
– Government debt security	Yes[3]	Yes, as two positions
– Corporate debt security	Yes	Yes, as two positions
– Index on interest rates	No	Yes, as two positions
OTC forwards		
– Government debt security	Yes[3]	Yes, as two positions
– Corporate debt security	Yes	Yes, as two positions
– Index on interest rates	No	Yes, as two positions
FRAs, swaps	No	Yes, as two positions
Forward foreign exchange	No	Yes, as one position in each currency
Options – Government debt security – Corporate debt security – Index on interest rates – FRAs, swaps	 Yes[3] Yes No No	Either (a) carve out together with the associated hedging positions: – simplified approach – contingent loss analysis or (b) apply the delta-plus method (gamma and vega should each receive a separate capital charge)

Equity position risk

16. Attachment B to APS 116 outlines requirements relating to the minimum capital requirement for equity position risk under the standard method.

17. The minimum capital charge for equities comprises separately calculated charges applying to the specific risk of holding a long or short individual equity position and to the general market risk of holding a long or short position in the market as a whole.

18. The following is an example of the treatment of an equity swap in which an ADI is receiving an amount based on the change in value of one particular equity or stock index and paying a different index; this will be treated as a long position in the former and a short position in the latter. Where one of the legs involves receiving/paying a fixed or floating interest rate, that exposure is entered into the appropriate repricing time band for interest-rate-related instruments as set out in Attachment B to APS 116. The stock index is covered by the equity treatment detailed in Attachment B to APS 116.

2 This is the specific risk charge relating to the issuer of the instrument. Counterparty credit risk is dealt with under APS 112.

3 The specific risk capital charge for derivatives with government debt securities as an underlying only applies to those securities that are rated below AA-.

19. The following is an example of how to determine whether a basket of shares represents at least 90 per cent of the index. If a stock represents five per cent of the index but the holding of that stock in the basket only represents 4.5 per cent of the total basket value, the percentage slippage of that stock is 0.5 per cent. Stocks that comprise the index but that are not held in the physical basket have a slippage equal to their percentage weight in the index. The sum of these differences across each stock in the index represents the total level of slippage from the index. In summing the percentage differences, no netting is applied between under market-weight and over market-weight holdings (i.e. the absolute values of the percentage slippages is summed). Deducting the total slippage from 100 gives the percentage coverage of the index, which is compared to the required minimum of 90 per cent.

Commodities risk

20. Attachment B to APS 116 outlines requirements relating to the minimum capital requirement for commodities risk under the standard method.

21. For spot or physical trading, the most important risk is that arising from a change in the spot price (directional risk). An ADI using portfolio strategies involving forward and derivative contracts is exposed to additional risks including:

    (a) basis risk (the risk that the relationship between the prices of similar commodities alters through time);

    (b) interest rate risk (the risk of a change in the cost of carry for forward positions and options);

    (c) forward gap risk (the risk that the forward price may change for reasons other than a change in interest rates).

Table 2 : Summary of treatment of equity derivatives

Instrument	Specific risk	General market risk
Exchange-traded or OTC futures		
Individual equity	Yes	Yes, as underlying
Index	2%	Yes, as underlying
Options		Either
Individual equity	Yes	(a) carve out together with the associated hedging positions
Index	2%	– simplified approach
		– contingent loss analysis
		or
		(b) general market risk charge according to the delta-plus method (gamma and vega should each receive a separate capital charge)
		Rho risk may be included with other interest rate exposures.

Treatment of options

22. Attachment B to APS 116 requires an ADI to seek approval from APRA to use an approach to the treatment of options.

23. The *delta-plus method* uses the sensitivity parameters or 'greeks' associated with options to measure their market risk capital requirements. Under this method, the delta-equivalent position of each option becomes part of the standard methodology, with the delta-equivalent amount subject to the applicable general market risk charges. Separate capital charges are then applied to the gamma and vega risks of the option positions.

24. The *contingent loss approach* uses simulation techniques to calculate changes in the value of an options portfolio for changes in the level and volatility of the prices of its associated underlyings. Under this approach, the general market risk charge is determined by the largest loss produced by a scenario 'matrix' (i.e. a specified combination of underlying asset price and volatility changes).

25. The following is an example of the application of the simplified approach. If a holder of 100 shares currently valued at $10 each holds an equivalent put option with a strike price of $11, the capital charge would be: $1,000 x 16% (i.e. 8% specific plus 8% general market risk) = $160, less the amount the option is in the money ($11 - $10) x 100 = $100, hence the capital charge would be $60. A similar methodology applies for options whose underlying is a foreign currency, an interest rate related instrument or a commodity.

26. The following are examples of the application of the delta-plus method to positions with debt securities or interest rates as the underlying:

    (a) a bought call option on a June three-month bill future will, in April, be considered on the basis of its delta-equivalent value to be a long position with a maturity of five months and a short position with a maturity of two months;

    (b) a sold or written call option on a June three-month bill future will, in April, be similarly entered as a long position with a maturity of two months and a short position with a maturity of five months;

    (c) a two-month call option on a 10-year bond future where delivery of the bond takes place in September would be considered in April as a long bond position with a maturity of 10 years 5 months and a short position of five months deposit, both positions being delta-weighted; and

    (d) a bought two-year cap with semi-annual resets and a cap rate of 15 per cent is treated as a series of three bought call options on a forward rate agreement (FRA) with a reference rate of 15 per cent, each with a negative sign at the maturity date of the underlying FRA and a positive sign at the settlement date of the underlying FRA.

27. In order to approve an application to use the contingent loss method, APRA may ask an ADI to provide details regarding the precise construction of the analysis.

Key requirements of the internal model approach

28. Attachment C to APS 116 sets out the method by which an ADI must calculate its traded market risk, foreign exchange and commodities capital requirement (TFC capital requirement) when using an internal model to measure market risk.

29. Attachment C to APS 116 allows APRA to set multiplication factors for VaR and stressed VaR higher than three if an ADI does not adequately satisfy the requirements set out in Attachment C. If so, APRA will advise the ADI of the reasons for doing so. APRA will typically set the multiplication factors for VaR and stressed VaR no higher than five.

30. The TFC capital requirement for exposures included in an internal model can be expressed mathematically as:

$$Capital = Max\left\{VaR_{-1}, (M_1 + P) \times \frac{1}{60}\sum_{t=1}^{60} VaR_{-t}\right\} + Max\left\{SVaR_{-1}, (M_2 + P) \times \frac{1}{60}\sum_{t=1}^{60} SVaR_{-t}\right\} + \left\{IRC \text{ or } CR \text{ or } SRC\right\}$$

where:

VaR_{-t} = the value-at-risk (VaR) calculated t trading days earlier

VaR_{-1} = the VaR calculated for the preceding trading day

$SVaR_{-t}$ = the stressed VaR calculated t trading days earlier. Where stressed VaR is calculated less frequently than daily, the latest available prior calculation should be used.

$SVaR_{-1}$ = the stressed VaR calculated for the preceding trading day

M_1 = the multiplication factor for VaR set by APRA, subject to a minimum of three

M_2 = the multiplication factor for stressed VaR set by APRA, subject to a minimum of three

P = the plus factor, which depends on the ex post performance of the internal model, as determined by back-testing, subject to a minimum of zero and a maximum of one. The plus factor is applied to both VaR and stressed VaR, but based only on the back-testing results of the VaR measure.

IRC = the capital requirement for the incremental risk charge

$$= Max\left\{IRC_0, \frac{1}{12}\sum_{t=1}^{12} IRC_{-t}\right\}$$

CR = the capital requirement for the comprehensive risk charge

$$= Max\left\{CR_0, \frac{1}{12}\sum_{t=1}^{12} CR_{-t}\right\}$$

IDC_0 = the most recently calculated incremental risk charge, to be applied to positions for which the VaR includes an estimation of specific risk in accordance with Attachment C to APS 116

IDC_{-t} = the IRC calculated t weeks earlier

SRC = the specific risk charge, to be calculated according to the standard method for positions for which both (i) the VaR does not include an estimation of specific risk, and (ii) a comprehensive risk charge is not calculated.

CR_0 = the most recently calculated comprehensive risk charge, to be calculated for the correlation trading portfolio in accordance with Attachment C to APS 116

CR_{-t} = the comprehensive risk charge calculated t weeks earlier

General criteria

31. Attachment C to APS 116 requires an ADI to comply with minimum criteria when using an internal model for regulatory capital purposes.

32. In assessing whether the VaR model is implemented with integrity, APRA may consider the following:

    (a) the reliability of all systems used in the end-to-end processing of positions, valuation rates and other data required to generate the VaR output, including:

        (i) systems that capture positions, valuation rates and other data necessary to generate VaR model output;

        (ii) the VaR model system (including risk aggregation systems and output publishing), the back-testing system (including, where appropriate, systems used to adjust actual trading outcomes to remove the impact of income arising from factors other than market movements alone, such as fees, spreads and intra-day trading results) and the stress testing system; and

(iii) systems that transfer information between the systems referred to above, data storage and reconciliations and checks on completeness of capture and accuracy of data including sub-portfolio allocation;

(b) system development, change control and documentation; security and audit trails; system availability and contingency procedures; and network adequacy;

(c) operational statistics relating to the VaR model production process, including, for example, statistics relating to timeliness, number of re-runs required and the reliability of data feeds; and

(d) the robustness and independence of the daily process used to determine the accuracy of VaR output prior to its publication within the ADI.

33. Attachment C to APS 116 requires an ADI to use the results of stress tests in the assessment of capital adequacy. At a minimum, it will be expected that an ADI will develop a robust procedure whereby senior management considers stress test outcomes (and the likelihood of the occurrence of those stress tests) when assessing whether overall levels of capital are adequate. It is good practice for an ADI to develop an approach that directly incorporates suitably chosen stress test results in the calculation of internal capital. It is also good practice for an ADI to consider unutilised limits in the calculation of internal capital.

Qualitative standards

34. Attachment C to APS 116 requires an ADI to carry out an independent review of the risk measurement system and overall risk management process both initially (at the time when model approval is sought) and then at least once every three years as part of the ADI's internal audit process.

35. Depending on the scale and complexity of an ADI's market risk, it may be good practice for an ADI to carry out the audit review (as required in Attachment C) more frequently and possibly at least once every year.

Specification of market risk factors

36. Attachment C to APS 116 requires an ADI to specify in its risk management system an appropriate set of market risk factors.

Interest rates

37. It is good practice for an ADI to model the yield curve using one of a number of generally accepted approaches (e.g. by estimating zero-coupon yields), whereby the yield curve is divided into various maturity segments to capture variation in the volatility of rates across the yield curve, with one risk factor corresponding to each maturity segment.

38. An ADI could measure credit spread risk by either specifying separate yield curves for certain classes of instruments or by specifying credit spread curves. It is good practice for an ADI with significant exposure to credit instruments (e.g. corporate bonds, floating rate notes and credit default swaps) to specify separate yield or spread curves for subsets of the credit market in which the ADI has material exposure (e.g. broad ratings categories such as government, semi-government, AAA, AA, A and BBB).

Equity prices

39. It is good practice to have the sophistication and nature of the modelling technique that an ADI uses for a given market to correspond with the ADI's exposure to both the overall market and its concentration in individual equity issues in that market.

40. At a minimum, an ADI would typically have a risk factor that is designed to capture market-wide movements in equity prices (e.g. a market index). Positions in individual securities or in sector indices could then be expressed in 'beta-equivalents'[4] relative to this market-wide index.

41. A more detailed approach would typically have risk factors corresponding to various sectors of the overall equity market (e.g. industry sectors or cyclical and non-cyclical sectors). Positions in individual shares within each sector could also be expressed in beta-equivalents relative to the sector index.

42. The most extensive approach would typically have risk factors corresponding to the volatility of individual equity issues.

Commodity prices

43. Where an ADI has relatively limited positions in commodity-based instruments, a straightforward specification of commodity prices would normally entail one risk factor for each commodity price to which the ADI is exposed. Where the aggregate positions are quite small, an ADI could use a single risk factor for a relatively broad sub-category of commodities (e.g. a single risk factor for all types of oil).

Option prices

44. It is good practice for an ADI with relatively large and/or complex options portfolios to have detailed specifications of the relevant implied volatilities and to measure the implied volatilities of options positions broken down by different maturities and by the extent to which an option is in- or out-of-the-money.

Quantitative standards

45. Attachment C to APS 116 requires an ADI to calculate stressed VaR using value-at-risk model inputs calibrated to historical data from a continuous 12 month period of significant financial stress relevant to the ADI's portfolio. The choice of historical period is subject to APRA approval.

46. The stressed value-at risk measure is intended to replicate a value-at-risk calculation that would be generated on the ADI's current portfolio if the relevant market factors were experiencing a period of stress.

47. As an example, for many portfolios, APRA would normally consider that a 12-month period relating to significant losses in 2007/2008 would adequately reflect a period of such stress; although the ADI must consider other periods relevant to the current portfolio.

48. As no particular model is prescribed for the calculation of stressed VaR, different techniques might need to be used to translate the model used for value-at-risk into one that delivers a stressed value-at-risk.

49. It would be good practice for ADIs to consider applying anti-thetic[5] data, or applying absolute rather than relative volatilities to deliver an appropriate stressed value-at-risk.

50. In addition to reviewing the choice of historical observation period as part of an ADI's regular mode review process, it is considered good practice for the ADI to consider other triggers for a review, such as instances where VaR exceeds stressed VaR, or following significant changes in trading book exposure.

4 A beta-equivalent position would be calculated from a market model of equity price returns (such as the CAPM model) by regressing the return on the individual stock or sector index on the risk-free rate of return and the return on the market index.

5 Modelling valuation changes that are based on the magnitude of historic price movements, applied in both directions – irrespective of the direction of the historic movement.

Stress testing

51. Attachment C to APS 116 requires an ADI to have a comprehensive stress testing program. In addition to these requirements, it is good practice for an ADI to have a policy for stress testing which, at a minimum, outlines:

    (a) its rationale for the composition of its stress testing framework and the process by which it assesses the plausibility of the scenarios in that framework; and

    (b) the process for the prompt escalation of stress testing results to senior management where the stress tests reveal a significant vulnerability to a particular set of circumstances, and the identification of those responsible for ensuring such escalation.

52. It is good practice for an ADI to conduct stress tests that evaluate the sensitivity of portfolio value to changes in the internal model's assumptions about correlations. This test involves determining the historical range of variation for correlations and measuring risk on current positions using the extreme values of this historical range.

53. Where stress tests reveal a significant vulnerability to a particular set of circumstances, APRA envisages that an ADI would typically consider appropriate steps to manage the risk, such as reducing or hedging the exposure or increasing capital.

Model review

54. Attachment C to APS 116 allows APRA to review the quality of an ADI's internal model review practices. In addition to the criteria that APRA will consider, it is good practice for an ADI to have a policy for model validation and review that specifies at a minimum:

    (a) a procedure to classify the relative importance of models (e.g. by complexity and/or materiality), which may impact on the approach taken to model validation;

    (b) roles, responsibilities and authorities with respect to model validation, including independence requirements;

    (c) the minimum initial validation requirements and ongoing (or periodic) validation requirements;

    (d) the minimum requirements for model documentation and documentation for validation; and

    (e) the minimum requirements for maintenance of validation records (e.g. a model registry, for which it is good practice to include information such as the model importance, model owner, model developer, model validator and date last validated).

55. It is good practice for an ADI's validation of its internal model to include the following tests to demonstrate that assumptions made within the model are appropriate:

    (a) tests of distribution assumptions (e.g. the assumption of the normal distribution if used);

    (b) the use of the square root of time to scale from a one-day holding period to a 10-day holding period or where extrapolation or interpolation techniques are used (e.g. yield curve generation); or

    (c) pricing models.

56. Further to the regulatory back-testing programs, it is good practice for an ADI to carry out additional back-tests, which may include testing:

    (a) carried out using hypothetical changes in portfolio value that would occur were end-of-day positions to remain unchanged. This approach excludes fees, commissions, bid-ask spreads, net interest income and intra-day trading;

    (b) carried out for longer periods than required for the regular back-testing programme (e.g. three years). The longer time period generally improves the power of the back-testing. A longer time period may not be desirable if the VaR model or market conditions have changed to the extent that historical data are no longer relevant;

    (c) carried out using confidence intervals other than the 99 per cent confidence interval required under the quantitative standards; or

(d) of individual portfolios within the total portfolio.

57. An ADI could also use hypothetical portfolios to ensure that the model is able to account for particular structural features that may arise. Examples of this approach include:

    (a) where data histories for a particular instrument do not meet the quantitative standards set out in Attachment C to APS 116, and where the ADI has to map these positions to proxies, it is good practice for an ADI to ensure that the proxies produce conservative results under relevant market scenarios;

    (b) ensuring that material basis risks are adequately captured. This may include mismatches between long and short positions by maturity or by issuer; and

    (c) ensuring that the model captures concentration risk that may arise in an undiversified portfolio.

Treatment of specific risk

58. Attachment C to APS 116 allows an ADI to apply to APRA to use an internal model to calculate its specific risk capital charge.

59. No specific approach for capturing the IRC is prescribed in APS 116.

60. With respect to the requirement for a specific risk model to explain the historical price variation in a portfolio, the key ex ante measures of model quality are 'goodness-of-fit' measures. One often-used measure of this type is an R-squared measure from regression methodology. If this measure is to be used, the ADI's model would typically explain a high percentage, such as 90 per cent, of the historical price variation or would explicitly include estimates of the residual variability not captured in the factors included in the regression. For some types of models, it may not be feasible to calculate a goodness-of-fit measure. APRA envisages that, in such an instance, the ADI would normally agree an acceptable alternative measure with APRA.

61. To be robust to an adverse environment, a model will be expected to signal rising risk in such an environment. This could be achieved by incorporating into the historical estimation period of the model at least one full credit cycle and ensuring that the model would not have been inaccurate in the downward portion of the cycle, or by simulating historical or plausible worst-case environments.

62. In respect to capturing name-rated event risk, it is good practice for a specific risk internal model to be sensitive to material idiosyncratic differences between similar but not identical positions, e.g. between debt positions with different levels of subordination, maturity mismatches or credit derivatives with different default events.

63. For debt positions, event risk would be expected to include migration risk. For equity positions, APRA envisages that events that would typically be reflected in large changes or jumps in prices would be captured (e.g. merger break-ups/takeovers). In particular, it is good practice for an ADI to consider issues related to survivorship bias.

64. Attachment C to APS 116 requires that an ADI's IRC model must be based on the assumption of a constant level of risk over the one-year capital horizon. This assumption is consistent with the capital computations in the Basel II Framework. In all cases (loans, derivatives and repos), the Basel II Framework defines 'exposure at default' (EAD) in a way that reflects a roll-over of existing exposures when they mature. The combination of the constant level of risk assumption and the one-year capital horizon reflects supervisors' assessment of the appropriate capital needed to support the risk in the trading portfolio. It also reflects the importance to the financial markets of ADIs having the capital capacity to continue providing liquidity to the financial markets in spite of trading losses. Consistent with a 'going concern' view of an ADI, this assumption is appropriate because an ADI must continue to take risks to support its income-producing activities.

For regulatory capital adequacy purposes, it is not appropriate to assume that an ADI would reduce its VaR to zero at a short-term horizon in reaction to large trading losses. It also is not appropriate to rely on the prospect that an ADI could raise additional Tier 1 capital during stressed market conditions.

Framework for the use of back-testing

65. Attachment C to APS 116 requires an ADI to implement a back-testing program. Back-testing is the process of comparing actual trading results with model-generated risk measures to gauge the quality and accuracy of an ADI's risk measurement systems. If the comparison yields close results, the back-test raises no issues regarding the quality of the risk measurement model. In some cases, however, the comparison may uncover sufficient differences to indicate that problems almost certainly exist, either with the model or with the assumptions of the back-test. In between these two cases is a grey area where the test results are, on their own, inconclusive.

66. The VaR measures are intended to be larger than all but a certain fraction of the trading losses, where that fraction is determined by the confidence level of the VaR measure. Comparing the risk measures with the trading outcomes simply means that the ADI counts the number of times that the trading losses were larger than the risk measures. The fraction of greater-than-expected losses to total outcomes can then be compared with the intended level of coverage to gauge the performance of the ADI's risk model.

67. The purpose of the back-tests applied for capital adequacy purposes is to compare whether the observed percentage of outcomes covered by the VaR measure is consistent with a 99 per cent level of confidence. That is, they attempt to determine if an ADI's 99th percentile risk measures truly cover 99 per cent of the ADI's trading outcomes.

68. Comparing trading outcomes with a VaR measure based on a one-day holding period reduces the contamination arising from changes in portfolio composition during the holding period (which are reflected in actual profit and loss outcomes) but not in VaR numbers (which are calculated on a static end-of-day portfolio).

69. Concerns about 'contamination' of the trading outcomes are also relevant for one-day trading outcomes. That is, the overall one-day profit or loss may not be a suitable point of comparison, because it reflects the effects of intra-day trading, fee income and other income not attributable to outright position taking. A more sophisticated approach would generally involve a detailed attribution of income by source, including fees, spreads, market movements and intra-day trading results. In such a case, the VaR results would typically be compared with the income arising from market movements alone.

70. In addition, the back-test most closely aligned to the VaR calculation would typically be one based on the hypothetical changes in portfolio value that would occur if end-of-day positions were to remain unchanged. That is, instead of looking at a day's actual profit or loss, the profit or loss obtained from applying the day's price movements to the previous day's end-of-day portfolio is calculated. This hypothetical profit or loss result can then be compared against the VaR based on the same, static end-of-day portfolio.

The three-zone approach

71. In view of the statistical limitations of back-testing, the supervisory interpretation of back-testing results encompasses a range of possible responses, depending on the strength of the signal generated from the back-test. These responses are classified into three zones, distinguished by colours. The green zone corresponds to back-testing results that do not themselves suggest a problem with the quality or accuracy of an ADI's model. The yellow zone encompasses results that do raise questions in this regard, but such a conclusion is not definitive.

The back-testing results could be consistent with either accurate or inaccurate models, and APRA will require an ADI to present additional information about its model before taking action. The red zone indicates a back-testing result that almost certainly indicates a problem with an ADI's risk model and APRA will require some action to be initiated.

The green zone

72. Since a model that truly provides 99 per cent coverage would be quite likely to produce as many as four exceptions in a sample of 250 outcomes, there is little reason for concern raised by back-testing results that fall in this range. In such a case, the multiplication factor will not be increased (the plus factor will be zero) and no other action from the ADI will be required.

The yellow zone

73. The range from five to nine exceptions constitutes the yellow zone. Outcomes in this range are plausible for both accurate and inaccurate models, although they are generally more likely for inaccurate models than for accurate models. Moreover, the presumption that the model is inaccurate should grow as the number of exceptions increases in the range from five to nine.

74. Within the yellow zone, the number of exceptions would generally guide the size of potential supervisory increases in an ADI's capital requirement. It is important to stress, however, that these increases are not meant to be purely automatic. Nevertheless, to keep the incentives aligned properly, back-testing results in the yellow zone would generally be presumed to imply an increase in the multiplication factor unless the ADI can demonstrate that such an increase is not warranted.

75. In such a situation, there are many different types of additional information that might be relevant to an assessment of the ADI's model. For example, it would be particularly valuable to see the results of back-tests covering disaggregated subsets of the ADI's overall trading activities. Many ADIs that engage in regular back-testing programs break up their overall trading portfolio into trading units organised around risk factors or product categories. Disaggregating in this fashion could allow the tracking of a problem that surfaced at the aggregate level back to its source at the level of a specific trading unit or risk model.

76. An ADI would also be expected to document all of the exceptions generated from its ongoing back-testing program, including an explanation for the exceptions. An ADI's documented explanations for exceptions will be used by APRA in determining an appropriate supervisory response to a back-testing result in the yellow zone. ADIs may also implement back-testing for confidence intervals other than the 99th percentile, or may perform other statistical tests not considered here.

77. In practice, there are several possible explanations for a back-testing exception, some of which go to the basic integrity of the model, some of which suggest an under-specified or low-quality model and some of which suggest either bad luck or poor intra-day trading results. Each of these problems is considered below. Classifying the exceptions generated by an ADI's model into these categories can be a useful exercise:

Basic integrity of the model

(a) the ADI's systems simply are not capturing the risk of the positions themselves (e.g. the positions of an overseas office are being reported incorrectly);

(b) model volatilities and/or correlations are calculated incorrectly;

Model's accuracy could be improved

(c) the risk measurement model is not assessing the risk of some instruments with sufficient precision (e.g. too few maturity buckets or an omitted spread);

Bad luck or markets moved in fashion unanticipated by the model

(d) random chance (a very low-probability event);

(e) markets moved by more than the model predicted (i.e. volatility was significantly higher than expected);

(f) markets did not move together as expected (i.e. correlations were significantly different to what was assumed by the model); or

Intra-day trading

(g) there was a large (and loss-making) change in the ADI's positions or some other income event between the end of the first day (when the risk estimate was calculated) and the end of the second day (when trading results were tabulated).

78. The first category of problems relating to the basic integrity of the risk measurement model is potentially the most serious. If there are exceptions attributed to this category for a particular trading unit, APRA is likely to apply the plus factor set out in Table 1 of Attachment C. In addition, the model may be in need of review and/or adjustment and APRA is likely to require the ADI to make the appropriate corrections.

79. The second category of problem (lack of model precision) is one that can be expected to occur at least part of the time with most risk measurement models. All models involve some amount of approximation. If, however, a particular ADI's model appears more prone to this type of problem than others, APRA is likely to impose the plus factor and require the ADI to improve its risk measurement techniques.

80. The third category of problem (markets moved in a fashion unanticipated by the model) can also be expected to occur at least some of the time with VaR models. The behaviour of the markets may shift so that previous estimates of volatility and correlation are less appropriate. No VaR model will be immune from this type of problem; it is inherent in the reliance on past market behaviour as a means of gauging the risk of future market movements. Exceptions for such reasons do not suggest a problem. However, if the shifts in volatilities and/or correlations are deemed to be permanent, APRA may require the ADI to recalculate its VaR using volatilities and correlations based on a shorter historical observation period.

81. Finally, depending on the definition of trading outcomes employed for the purpose of back-testing, exceptions could also be generated by intra-day trading results or an unusual event in trading income other than from positioning. Although exceptions for these reasons would not necessarily suggest a problem with the ADI's VaR model, they could still be a cause for concern and the imposition of the plus factor will be considered.

82. The extent to which a trading outcome exceeds the risk measure is another relevant piece of information. Exceptions generated by trading outcomes far in excess of the risk measure are a matter of greater concern than are outcomes only slightly larger than the risk measure.

The red zone

83. In contrast to the yellow zone, where APRA may exercise judgement in interpreting the back-testing results, outcomes in the red zone (ten or more exceptions) will generally lead to the presumption that a problem exists with an ADI's model. This is because it is extremely unlikely that an accurate model would independently generate ten or more exceptions from a sample of 250 trading outcomes.

84. In general, therefore, if an ADI's model falls into the red zone, APRA will increase the scaling factor applicable to the model by one. APRA will also investigate the reasons why the ADI's model produced such a large number of exceptions and will require the ADI to begin work on improving its model immediately. In the case of severe problems with the basic integrity of the model, APRA may disallow the use of the model for capital purposes altogether.

85. Although ten exceptions is a very high number for 250 observations, there may, on very rare occasions, be a valid reason why an accurate model will produce so many exceptions. In particular, when financial markets are subjected to a major regime shift, many volatilities and correlations can be expected to shift as well, perhaps substantially. Such a regime shift could generate a number of exceptions in a short period of time. One possible response by APRA in this instance may be to require the ADI's model to take account of the regime shift as quickly as it can while maintaining the integrity of its procedures for updating the model.

Example: calculation of general market risk for interest rate-related instruments in the standard method – maturity method

86. As an example of the application of the interest rate risk calculation requirements in Attachment B to APS 116, assume that an ADI has the following positions:

    (a) a qualifying bond, $13.33 million market value, residual maturity eight years, coupon eight per cent;

    (b) a government bond, $75 million market value, residual maturity two months, coupon seven per cent;

    (c) an interest rate swap, $150 million[6], on which the ADI receives floating rate interest and pays fixed, the next interest fixing occurs after nine months, residual life of the swap eight years; and

    (d) a long position in interest rate futures of $50 million, maturing in six months time, life of underlying government security 3.5 years.

87. Table 1 shows how these positions are entered into the time bands and are weighted according to the weights given in Table 2 of Attachment B to APS 116. After weighting the positions, the next steps in the calculation under the maturity method are as follows:

    (a) the overall net position (+ 0.15 - 0.20 + 1.05 + 1.125 - 5.625 + 0.5) is -3.00, leading to a capital charge of $3 million;

    (b) the vertical disallowance in time band 7-10 years has to be calculated. The matched position in this time band is 0.5 (the lesser of the absolute values of the added (weighted) long and (weighted) short positions in the same time band) which leads to a capital charge of 10 per cent of 0.5 = $0.05 million. The remaining net (short) position is -5.125. Since there are no positions in other zone 3 time bands, this is the net position in zone 3;

    (c) the horizontal disallowances within the zones have to be calculated. As there is more than one position in zone 1 only, a horizontal disallowance need only be calculated in this zone. In doing this, the matched position is calculated as 0.2 (the lesser of the absolute values of the added long and short positions in the same zone). The capital charge for the horizontal disallowance within zone 1 is 40 per cent of 0.2 = $0.08 million. The remaining net (long) position in zone 1 is +1.00;

6 The position is reported as the market value of the notional underlying. Depending on the current interest rate, the market value of each leg of the swap (i.e. the 8-year bond and the 9-month floating leg) can be either higher or lower than the notional amount. For the sake of simplicity the example assumes that the current interest rate is identical to the interest rates on which each leg of the swap is based.

(d) the horizontal disallowances between adjacent zones have to be calculated. After calculating the net position within zone 1 the following positions remain:

zone 1 +1.00

zone 2 +1.125

zone 3 -5.125.

(e) The matched position between zones 2 and 3 is 1.125 (the lesser of the absolute values of the long and short positions between adjacent zones). The capital charge in this case is 40 per cent of 1.125 = $0.45 million; and

(f) the horizontal disallowance between zones 1 and 3 has to be calculated. After offsetting the +1.125 in zone 2 against the -5.125 in zone 3 this leaves -4.00 in zone 3, which can be offset against the +1.00 in zone 1. The horizontal disallowance between the two zones is 100 per cent of the matched position, which leads to a capital charge of 100 per cent of 1.00 = $1.00 million.

The total capital charge ($ million) in this example is:

– for the overall net open position	3.00
– for the vertical disallowance	0.05
– for the horizontal disallowance in zone 1	0.08
– for the horizontal disallowance between adjacent zones	0.45
– for the horizontal disallowance between zones 1 and 3	1.00
Total	4.58

Table 3 : Summary of example calculations – maturity method ($ million)

	Zone 1				Zone 2			Zone 3					
Time band	0-1	1-3	3-6	6-12	1-2	2-3	3-4	4-5	5-7	7-10	10 -15	15 -20	Over 20
	Months				Years								
Position		+75 Govt.	-50 Fut.	+150 Swap			+50 Fut.			-150 Swap +13.33 Qual.			
Weight (%)	0.00	0.20	0.40	0.70	1.25	1.75	2.25	2.75	3.25	3.75	4.50	5.25	6.00
Position x Weight		+0.15	-0.20	+1.05			+1.125			-5.625 +0.5			
Vertical Disallow.										0.5 x 10% = 0.05			
Horizont. Disallow. 1	0.20 x 40% = 0.08												
Horizont. Disallow. 2					1.125 x 40% = 0.45								
Horizont. Disallow. 3	1.0 x 100% = 1.0												

Example: calculation of equity position risk in arbitrage portfolios in the standard method

88. Attachment B to APS 116 outlines requirements relating to the calculation of an ADI's equity position risk.

89. For physical-futures index arbitrage, concessional treatment is applied where the composition of the physical basket of shares represents at least 90 per cent of the index when broken down into its notional components. To determine whether a basket of shares represents at least 90 per cent of the index, the relative weight of each stock in the physical basket is compared to the weight of each stock in the index. Where the sum of the absolute values of the percentage differences exceeds 10 per cent, the coverage requirement is not met.

90. As an example of the application of the equity position risk requirements in Attachment B to APS 116, assume that the index is made up of 6 stocks in the following proportions:

    Stock A 40% Stock D 14%

    Stock B 20% Stock E 10%

    Stock C 15% Stock F 1%

91. In the physical portfolio, the following amounts of stocks are held:

    Stock A 38% Stock D 15%

    Stock B 20% Stock E 9%

    Stock C 18% Stock F 0%

92. The extent of slippage is then calculated as:

    |40%-38%|+|20%-20%|+|15%-18%|+|14%-15%|+|10%-9%|+|1%-0%| = 8%

    Because the slippage is less than 10 per cent, at least 90 per cent of the index is covered by the physical position and, as a result, the requirement is met.

Example: calculation of foreign exchange risk in the standard method

93. As an example of the application of the foreign exchange risk calculation requirements in Attachment B to APS 116, assume that the ADI has the following net positions in each currency (measured in AUD):

JPY	EUR	GBP	CHF	USD	GOLD
+50	+100	+150	-20	-180	-35
	+300		-200		35

94. The capital charge for foreign exchange risk would be eight per cent of the higher of either the net long currency positions or the net short currency positions (300) and of the net position in gold (35) = 335 x 8% = $26.8 million.

Example: calculation of the treatment of gold and commodities risk in the standard method

95. Attachment B to APS 116 outlines requirements relating to the calculation of an ADI's foreign exchange risk and commodities risk.

Treatment of the foreign currency denomination of gold

96. As an example of the application of these requirements in Attachment B to APS 116, assume that the ADI purchased 100 ounces of gold at 395.90 USD/oz and that the AUD/USD exchange rate is 0.7956. In AUD terms, the gold position is a long position of 100 × 395.90/0.7956 = AUD 49,761. It is assumed that the ADI purchased the gold by paying AUD.

97. Assume that the ADI has the following existing foreign exchange positions (measured in AUD):

JPY	GBP	CHF	USD	GOLD
+50,000	+150,000	-20,000	-100,000	0

98. Double counting of the long position in gold adds the following positions:

JPY	GBP	CHF	USD	GOLD
0	0	0	49,761	49,761

99. The resulting new net positions are:

JPY	GBP	CHF	USD	GOLD
+50,000	+150,000	-20,000	-50,239	49,761
+200,000		-70,239		49,761

100. The capital charge is eight per cent of the higher (in absolute value) of either the net long or short currency positions plus the net gold position:

8% × (200,000 + 49,761) = AUD 19,981.

Treatment of the foreign currency denomination of a commodity

101. Assume that the ADI purchases 5,000 ounces of silver at 5.385 USD/oz and that the AUD/USD exchange rate is 0.7956. In AUD terms, the position is a long position in silver of 5,000 × 5.385/0.7956 = AUD 33,842. It is assumed that the ADI purchased the silver by paying AUD.

102. Assume that the ADI has the following existing foreign exchange positions (measured in AUD):

JPY	CHF	USD	GOLD
+20,000	-20,000	-50,000	10,000

103. Double-counting of the long position in silver adds the following position:

JPY	CHF	USD	GOLD
0	0	33,842	0

104. The resulting new net positions are:

JPY	CHF	USD	GOLD
+20,000	-20,000	-16,158	10,000
+20,000	-36,158		10,000

105. The foreign exchange capital charge is 8% × (36,158 + 10,000) = AUD 3,693.

106. The capital charge for silver (based on the simplified approach) is set at 15 per cent of the net position plus three per cent of the gross position, which in this case is:

18% × 33,842 (since there is only one position) = AUD 6,092.

Maturity ladder approach for commodities risk

107. Assume that an ADI has four forward purchases and sales of aluminium with the following maturities and in AUD values.

Purchase or Sale	Maturity	Value (AUD)
Purchase	4 months	800
Sale	5 months	1,000
Purchase	2.5 years	600
Sale	7 years	600

108. All positions are taken to be in the same commodity, as defined in Attachment B to APS 116, and converted at current spot rates into AUD (without double-counting for foreign exchange exposure).

Table 4 : Summary of example calculations – maturity ladder approach			
Time band	Position (AUD)	Capital calculation	Capital charge
0-1 month			
1-3 months			
3-6 months	Long 800 Short 1,000	800 matched position x 3% =	24.0
6-12 months			
1-2 years			
2-3 years	Long 600	200 short carried forward 3 time bands from 3-6 months: 200 x 3 x 0.6% = 200 matched position x 3% =	 3.6 6.0
over 3 years	Short 600	400 long carried forward one time band from 2-3 years: 400 x 1 x 0.6% = 400 matched position x 3% = Net position of 200: 200 x 15% =	 2.4 12.0 30.0

109. The total capital charge will be
24 + 3.6 + 6 + 2.4 + 12 + 30 = AUD 78.

Example: calculation of the delta-plus method for options

110. Attachment B to APS 116 outlines requirements relating to the treatment of options.

A single commodity option

111. As an example of the application of these requirements in Attachment B to APS 116, assume an ADI has an European short call option on a commodity with an exercise price of 490, a market value of the underlying 12 months from the expiration of the option of 500; a risk-free interest rate of eight per cent per annum and an assumed current (implied) volatility of 20 per cent per annum. The current delta for this position is, according to the Black-Scholes formula, -0.721 (i.e. the price of the option changes by -0.721 if the price of the underlying moves by 1). The gamma is -0.0034 (i.e. the delta changes by -0.0034, from -0.721 to -0.7244, if the price of the underlying moves by 1). The current value of the option is 65.48.

112. The following example shows how the capital charges will be calculated according to the delta-plus method.

113. The first step under this method is to multiply the market value of the commodity by the absolute value of the delta:

    5000.721 = 360.5.

    The delta-weighted position then has to be incorporated into the framework described in Attachment B to APS 116. If the ADI uses the maturity ladder approach and no other positions exist, the delta-weighted position has to be multiplied by 0.18 (0.15 +0.03) to calculate the capital charge for delta:

    360.5 × 0.18 = 64.89.

114. The capital charge for gamma risk is then calculated according to the formula set out in paragraph 83 in Attachment B to APS 116:

    ½ × 0.0034 × (500× 0.15)2 = 9.5625.

115. The capital charge for vega risk is then calculated separately. The assumed current (implied) volatility is 20 per cent. As only an increase in volatility carries a risk of loss for a short call option, the volatility has to be increased by a relative shift of 25 per cent. This means that the vega capital charge has to be calculated on the basis of a change in volatility of five percentage points from 20 per cent to 25 per cent in this example. According to the Black-Scholes formula used here the vega equals 168. Thus a one per cent or 0.01 increase in volatility increases the value of the option by 1.68. Accordingly, a change in volatility of five percentage points increases the value by:

    5 × 1.68 = 8.4

    which is the capital charge for vega risk.

116. The total capital charge against the commodity option is:

    64.89 + 9.5625 + 8.4 = 82.8525.

A portfolio of foreign exchange options

117. Assume an ADI has a portfolio of options with the characteristics in Table 5.

118. The first step is to multiply the absolute value of each option's delta by the market value of the underlying currency position (see Table 6). This leads to the following net positions in each currency:

    USD -242.80

    GBP +57.85

    JPY -57.85

    Assuming that the ADI holds no other foreign currency positions, inclusion of these positions into the framework set out in Attachment B to APS 116 yields a net open position of 300.65 and a capital charge of 24.05 (300.62 × 0.08).

119. The gamma impact (see Table 6) for each option is calculated as:

½ × gamma × (market value of underlying × 0.08)2

For each underlying, in this case each currency pair, a net gamma impact is obtained:

AUD/USD -4.00

GBP/JPY +0.32 Only the negative gamma impacts are included in the capital calculation, hence the gamma charge here is 4.00.

Table 5 : Options portfolio example

Option	Currency pair	Market value of underlying (AUD)	Delta	Gamma	Vega	Assumed volatility (%)
1	AUD/USD	100	-0.803	0.0018	1.84	5
2	AUD/USD	600	-0.519	-0.0045	-3.87	20
3	AUD/USD	200	0.182	-0.0049	-0.31	20
4	AUD/USD	300	0.375	0.0061	4.97	10
5	GBP/JPY	100	-0.425	0.0065	5.21	10
6	GBP/JPY	50	0.639	-0.0016	-4.16	7
7	GBP/JPY	75	0.912	0.0068	3.15	5

Table 6 : Example of gamma impact

Option	Currency Pair	Delta × market value of underlying	Gamma impact
1	AUD/USD	-80.30	0.0576
2	AUD/USD	-311.40	-5.1840
3	AUD/USD	36.40	-0.6272
4	AUD/USD	112.50	1.7568
5	GBP/JPY	-42.50	0.2080
6	GBP/JPY	31.95	-0.0128
7	GBP/JPY	68.40	0.1224

Table 7: Example of vega impact					
Option	Currency pair	Assumed volatility (%)	Vega	Volatility shift (percentage points)	Change in value (AUD)
1	AUD/USD	5	1.84	1.25	2.30
2	AUD/USD	20	-3.87	5.00	-19.35
3	AUD/USD	20	-0.31	5.00	-1.55
4	AUD/USD	10	4.97	2.50	12.43
5	GBP/JPY	10	5.21	2.50	13.03
6	GBP/JPY	7	-4.16	1.75	-7.28
7	GBP/JPY	5	3.15	1.25	3.94

120. The vega capital charge is based on the assumed implied volatilities for each option. Multiplying the 25 per cent volatility shifts with each option's vega yields the assumed price changes (shown in Table 7). These are then summed for each currency pair. The net vega impact for each currency pair is:

AUD/USD -6.18

GBP/JPY +9.68

Since no netting of vegas is permitted across currency pairs, the capital charge is calculated as the sum of the absolute values obtained for each currency pair: 6.18 + 9.68 = 15.86.

121. The total capital charge arising from the options portfolio is:

24.05+4.00+15.86 = 43.91.

Example: calculation of the contingent loss approach for options

122. As an example of the application of requirements relating to the treatment of options in Attachment B to APS 116, consider an ADI holding a portfolio comprised of positions in two stocks and two accompanying options positions, as set out in Table 8 and 9.

123. Applying the price movements over the range ±8% to the share positions yields the changes in portfolio value shown in Table 10.

Table 8: Share portfolio		
Position	No. of shares	Current price ($)
Long BHP	100	19.09
Short TNT	50	1.79

Table 9: Options portfolio					
Position	No of shares	Option type	Time to expiry (yrs)	Strike price ($)	Current volatility (%)
Long BHP	50	Call	0.45	20.00	0.15
Short TNT	20	Put	0.36	2.25	0.42

124. Applying the matrix of price and volatility movements to the ADI's holding of BHP call options results in the changes in the value of that position shown in Table 11.

125. Similar calculations give the exposure arising from the short TNT put options (refer Table 12).

126. Summing the changes in value for each option and underlying share position yields the contingent loss matrix for the total portfolio (refer Table 13).

127. The capital charge is then set equal to the largest loss arising within the matrix – in this case, 161.87.

Table 10: Change in value of share positions

Position	Assumed price change (%)						
	-8.00	-5.33	-2.67	0.00	2.67	5.33	8.00
BHP	-152.72	-101.81	-50.91	0.00	50.91	101.81	152.72
TNT	7.16	4.77	2.39	0.00	-2.39	-4.77	-7.16

Table 11: BHP options – change in value

Assumed volatility change (%)	Assumed price change (%)						
	-8.00	-5.33	-2.67	0.00	2.67	5.33	8.00
+25	-8.26	-4.38	0.98	8.02	16.93	27.78	40.58
0	-12.10	-9.63	-5.73	0.00	7.88	18.13	30.81
-25	-14.30	-13.27	-11.12	-7.20	-0.83	8.52	21.08

Table 12: TNT options – change in value

Assumed volatility change (%)	Assumed price change (%)						
	-8.00	-5.33	-2.67	0.00	2.67	5.33	8.00
+25	-2.81	-2.07	-1.36	-0.68	-0.02	0.62	1.22
0	-2.32	-1.52	-0.75	0.00	0.72	1.41	2.08
-25	-2.00	-1.14	-0.29	0.53	1.33	2.10	2.84

Table 13: Total portfolio – change in value

Assumed volatility change (%)	Assumed price change (%)						
	-8.00	-5.33	-2.67	0.00	2.67	5.33	8.00
+25	-156.62	-103.49	-48.91	7.35	65.43	125.43	187.36
0	-159.98	-108.19	-54.99	0.00	57.12	116.59	178.45
-25	-161.87	-111.45	-59.93	-6.66	49.03	107.66	169.48

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