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RESERVE BANK OF INDIA
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The Chairmen and Managing Directors/
Chief Executive Officers of
All Commercial Banks
(Excluding Regional Rural Banks and Local Area Banks)

Dear Sir,

Prudential Guidelines on Capital Adequacy -
Implementation of Internal Models Approach for Market Risk

Please refer to our circular DBOD BP. BC. 23/21.06.001/2009-10 dated July 7, 2009, *inter alia* advising banks desirous of moving to advanced approaches under Basel II that they can apply for migrating to Internal Models Approach for market risk from April 1, 2010 onwards, provided they are adequately prepared.

2. Basel II Framework offers a choice between two broad methodologies in measuring market risks for the purpose of capital adequacy. One methodology is to measure market risks in a standardised manner as per the **Standardised Measurement Method (SMM)** which is being used by banks in India since March 31, 2005. The alternative methodology known as **Internal Models Approach (IMA)** is also available which allows banks to use risk measures derived from their own internal market risk management models. The permissible models under IMA are the ones which calculate a value-at-risk (VaR)-based measure of exposure to market risk. VaR-based models could be used to calculate measures of both general market risk and specific risk. As compared to the SMM, IMA is considered to be more risk sensitive and aligns the capital charge for market risk more closely to the actual losses likely to be faced by banks due to movements in the market risk factors.

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3. The guidelines governing use of internal models for measuring the capital charge for market risk are annexed. To begin with banks in India may model general market risk and continue to use SMM for specific risk. However, banks should endeavour to develop capabilities to model specific risk including Incremental Risk.

4. Banks interested in migrating to IMA for computing capital charge for market risk are advised to assess their preparedness with reference to these guidelines. As and when they are ready for introduction of IMA, they may first give Reserve Bank of India (RBI) (Chief General Manager-in-Charge, Reserve Bank of India, Department of Banking Operations & Development, Central Office, 12th Floor, Shahid Bhagat Singh Road, Mumbai - 400001), a notice of intention for the same. RBI will first make a preliminary assessment of the bank's risk management system and its modelling process. If the result of this preliminary assessment is satisfactory, then RBI will allow the bank to make a formal application for migrating to IMA in a prescribed format, which would be made available to banks in due course. RBI will then perform a detailed analysis of its model with a view to approving the same.

5. It may be reiterated that banks would have the discretion to adopt IMA for market risk, while continuing with simpler approaches for computation of capital charge for credit and operational risks.

Yours faithfully,

(B. Mahapatra)
Chief General Manager

Encls: as above

ANNEX

GUIDELINES ON IMPLEMENTATION OF INTERNAL MODELS APPROACH (IMA) FOR MARKET RISK

1. INTRODUCTION

1.1 Basel II Framework offers a choice between two broad methodologies for measuring market risks for the purpose of capital adequacy viz., Standardised Measurement Method (SMM) and Internal Models Approach (IMA). The SMM has already been implemented in India since March 31, 2005 as per the extant guidelines contained in our Master Circular on New Capital Adequacy Framework. The alternative method, viz., the IMA envisages use of banks' own internal market risk management models for deriving risk measures for determining regulatory capital requirements for market risk, after the internal models have been approved by the supervisor. Compared to the SMM, the IMA is considered to be more risk sensitive and aligns the capital charge for market risk more closely to the actual losses likely to be incurred by banks due to movements in the market risk factors. With a view, therefore, to provide a wider choice to banks in selecting a method for determining the regulatory capital requirement for their market risk exposure, it has been decided to introduce the IMA in India.

1.2 These guidelines seek to ensure that the internal risk management models of the banks used for capital adequacy and risk management purposes meet the prescribed qualitative and quantitative standards, and are subject to rigorous back-testing and stress testing methodologies before they are approved by the RBI for use by the banks in determining their regulatory capital requirements. These guidelines stipulate the regulatory requirements for seeking RBI approval for migration to the IMA by banks.

2. EFFECTIVE DATE AND TRIAL RUN OF THE IMA MODELS

2.1 As already advised vide our circular DBOD.BP.BC.No. 23/21.06.001/2009-10 dated July 7, 2009, banks are required to undertake an internal assessment of their preparedness for migration to advanced approaches under Basel II Framework and take a decision, with the approval of the Board, whether they would like to migrate to any of the advanced approaches. If a bank so decides to migrate to the IMA for

market risk, it should intimate the RBI (Chief General Manager-in-Charge, Banking Policy Division, DBOD, Central Office, 12th Floor, Central Office Building, Shahid Bhagat Singh Road, Mumbai – 400001) of its intention to do so any time from April 1, 2010 onwards. After receipt of the notice of intention, the RBI will undertake a preliminary screening of the banks to determine their eligibility to migrate to the IMA in terms of their preparedness and considering all other relevant factors. Thereafter, the RBI will call for from the banks considered eligible for IMA migration, a detailed application, supported by the documents enumerated in Appendix 4 of these guidelines. Before submitting the detailed application, the banks concerned should have used the IMA model parallel to the SMM for a period of at least two calendar quarters and also have back-tested them for performance during this period.

2.2 After grant of the RBI approval for the IMA model(s), the banks will be required to continue the back-testing of the model, after incorporating such changes into the model as may be advised by the RBI, for another two calendar quarters, before the capital charge for market risk for regulatory purposes can be computed as per the approved model. Till such effective migration to the IMA, the banks shall continue to use the SMM for determining the regulatory capital charge for market risk.

3. SCOPE OF APPLICATION

Application at solo and consolidated levels

3.1 These guidelines will apply to banks at the solo level (global position) as well as consolidated / group-wide level, excluding group companies which are engaged in insurance business. While computing market risk capital for the entire group, a bank should not off-set their long/short positions with the positions of its subsidiaries and also among the subsidiaries. This would mean that the capital charge for the bank and its individual subsidiaries would be calculated separately and summed up to arrive at the group level market risk capital. Banks can, however, apply the IMA to their market risk positions across the entire bank (solo level) including overseas branches on a net basis, except for the branches located in jurisdictions where there are obstacles to the quick repatriation of profits or where there are legal and procedural difficulties in carrying out the timely management of risks on a global

basis. Individual banks can make assessment of these aspects in respect of all of their overseas branches, document the same, and review it at least on an annual basis. Further, individual banks should also continue to monitor the market risks of their overseas operations separately, regardless of whether the positions across the overseas branches are off-set or not.

Types of risks covered

3.2 Market Risk is defined as the risk of losses in on and off-balance-sheet positions arising from movements in market prices. In the context of a portfolio, the market risk is a measure of the uncertainty in the distribution of portfolio returns. The different components of market risk can be categorised as shown below:

a) Interest Rate Risk
   - General Market Risk
   - Specific Risk
     - Default Risk
     - Credit Migration Risk
     - Credit Spread Risk
     - Incremental Risk

b) Equity Price Risk
   - General Market Risk
   - Specific Risk

c) Exchange Rate Risk

d) Commodity Price Risk (Not applicable for the banks in India as they are not allowed to trade in commodities at present).

A brief description of these risk categories is furnished at **Appendix 1.**

3.3 Under the IMA, the capital requirement for market risk will consist of the following two components, based on VaR measure:

a) General Market Risk Charge; and

b) Specific Risk Charge [including Incremental Risks Charge (IRC) for interest rate instruments].

3.4 These guidelines are meant for computing capital charge for market risk for

the risk components at (a), (b) and (c) at para 3.2 above. More specifically, the guidelines for the IMA will be applicable to:

a) The risks pertaining to interest rate-related instruments and equities in the trading book;

b) Exchange rate risk (including open position in gold) throughout the bank, that is, both in the banking book and trading book;

   [In the case of foreign currency instruments, including derivatives, in addition to the exchange rate risk, the interest rate risk and equity price risk, as applicable, will also have to be captured;] and

c) The risks relating to investments in mutual funds kept in trading book.

3.5 At present, the SMM is applicable to both Held-For-Trading (HFT) and Available for Sale (AFS) portfolios. Generally, the positions held in the AFS are more illiquid and the market prices for them may not be available or may be available with a very low frequency due to low trading volumes. Therefore, it would not be feasible to compute meaningful VaR measures for AFS portfolios. Accordingly, the "trading book" for the purpose of these guidelines will consist of only Held-For-Trading (HFT) portfolio, which will also include trading positions in derivatives and the derivatives transactions entered into for hedging trading book exposures. The AFS portfolio should continue to be under SMM for computation of capital charge for market risk.

Ongoing monitoring

3.6 Under the extant capital adequacy norms, banks are required to maintain the prescribed CRAR on an ongoing basis. Hence, the banks should put in place a system to ensure that the market risk capital charge under the IMA also is maintained at the close of business every day. Banks are also expected to institute effective risk management systems to ensure that their intra-day market-risk exposures do not become excessive.

4. COMBINATION OF IMA AND SMM FOR MARKET RISK CAPITAL CHARGE

4.1 As indicated in para 3.1 above, these guidelines should normally apply to the banks at the solo level (global position) as well as consolidated / group-wide level.

4.2 However, taking into account the lack of preparedness by some of the group level entities of banks, it may be desirable that to start with, the parent in the group and entities which are in a position to model market risk use VaR model for computation of capital charge for market risk and other entities in the group which are not in a position to model market risk may follow SMM. The group level capital for market risk would be the sum of the capital requirement calculated for entities under VaR model and for the other entities calculated under SMM. However, the banking group should endeavour to move over to VaR model for the entire group in due course.

Combination of SMM and IMA

4.3 The internal models approach will in principle require banks to have an integrated risk measurement system that captures the broad risk factor categories (i.e. interest rates, exchange rates (which may include gold), equity prices, with related options volatilities being included in each risk factor category. However, if a bank's exposure to a particular risk factor is insignificant, it may request, in its letter of intent, exemption from application of standards of these guidelines for that risk factor. For such factors RBI, may allow banks to use the SMM for calculation of capital. However, banks which start to use models for one or more risk factor categories will, over time, be expected to extend the models to all their market risks. A bank which has developed one or more models will no longer be able to revert to measuring the risk measured by those models according to the SMM (unless, of course, RBI withdraws approval for that model). However, pending further experience regarding the process of changing to a models-based approach, no specific time limit will be set for banks now which use a combination of internal models and the SMM to move completely to IMA. The conditions mentioned below will apply to banks using such combinations.

4.4 Banks can adopt the IMA for one or more of the broad risk factors and remain on SMM for other risk factors. However, each broad risk factor category must be assessed using a single approach (either internal models or the standardised approach), i.e. no combination of the two methods will in principle be permitted within

a risk category or across banks' different entities for the same type of risk. However, as per para 4.2 above, considering the preparedness of the banks for migration to IMA, banks have been given flexibility in including all their operations on a worldwide basis and across entities. This flexibility will be subject to explicit approval of RBI and will be reviewed regularly to ensure that there is no cherry-picking between SMM and IMA within a risk factor category. Whenever, banks incur risks in positions which are not captured by their models, for example, in remote locations, in minor currencies or in negligible business areas, such risks may be measured according to standardised methodology. However, as stated above, banks should progressively adopt IMA for all broad risk factors so as to achieve integrated risk measurement system. In this regard, banks have to produce before RBI a credible plan for extending IMA to entire spectrum of market risk exposure.

4.5 No element of market risk may escape measurement, i.e. the exposure for all the various risk factors, whether calculated according to the standardised approach or internal models would have to be captured;

4.6 The capital charges assessed under the standardised approach and under the internal models approach are to be aggregated according to simple summation.

4.7 Normally, a bank which has received approval to use the IMA to calculate its market risk capital requirement for certain exposures shall not be allowed to revert to calculating the market risk capital requirement for those types of exposures using the SMM.

4.8 If a bank becomes aware after adopting the IMA that any of the conditions/representations made by it subject to which the approval was granted, are no longer valid or that it no longer complies with any of the conditions or restrictions imposed by RBI, it shall –

i. inform RBI immediately;

ii. assess the effect of the situation in terms of the risk posed to the bank;

iii. prepare a plan to rectify the situation and inform RBI of its plan as soon as possible; and

iv. undertake prompt corrective action within a reasonable time in

accordance with the plan prepared pursuant to sub-paragraph (iii) above.

4.9 The bank shall seek the approval of RBI before it makes any change (such as trading strategies, new business, modifications to its scope, significant change in the systems or in the quantitative or qualitative requirements, etc.) to its IMA framework (including its internal models) for market risk. Prior to receiving approval for any change to its internal models, the bank shall continue to use the existing internal models to calculate its market risk capital requirement for the affected exposures.

5. PRUDENTIAL FLOORS

Banks which migrate to the IMA for market risk capital charge after obtaining RBI approval may also calculate capital charge for market risk as per existing SMM for at least three years from the date of migration. The minimum capital requirement for market risk during the said three years will be subject to the following prudential floors:

Years →	Year 1	Year 2	Year 3
Prudential Floor (as percentage of minimum capital requirement as per current SMM)	100	90	80

RBI will review the performance of the IMA in banks on an on-going basis and will take a decision on continuance of prudential floors or otherwise after three years of a bank adopting the IMA.

6. BROAD PRINCIPLES FOR GRANTING RBI APPROVAL FOR MIGRATION TO THE IMA

Once a bank decides to adopt the IMA, it can start using internal models for market risk only after obtaining approval of the models from the RBI. The RBI approval will be guided by such criteria and be subject to such conditions and restrictions as it may consider necessary. The extent to which a bank meets these criteria will be taken into account in determining the level of multiplication factors for the VaR measure, referred to in para 9.14. The grant of RBI approval to a bank to migrate to IMA will be guided by the following broad principles at the minimum:

a) The assessment of a bank's risk management system on the parameters of conceptual soundness and its implementation with integrity;

b) Availability of sufficient number of skilled staff in the use of sophisticated models not only in the trading area but also in the risk control, audit and back office areas, as viewed by the RBI;

c) A proven track record of the bank's models in measuring risk with reasonable accuracy, in RBI's judgement;

d) Regular conduct of stress tests by the bank along the lines mentioned in these guidelines;

e) A period of initial monitoring and live testing of a bank's internal models, pre- and post-approval of the model by the RBI, before it is used for capital adequacy purpose.

7. QUALITATIVE CRITERIA FOR IMA APPROVAL – CORPORATE GOVERNANCE OF RISK

It is important for banks applying to use internal models to demonstrate that they have market risk management systems that are conceptually sound and implemented with integrity. Accordingly, the quality of risk governance in the banks will have to meet a number of criteria before they are permitted to use the IMA for market risk. The extent to which banks meet these criteria may influence the level at which RBI will set the multiplication factor referred to in para 9.14**.** Only the banks in full compliance with these criteria will be eligible for application of the minimum multiplication factor. These criteria are broadly outlined below:

Board and Senior Management Oversight of Risk Management

7.1 A bank's Board has an essential oversight role in risk management and should set basic goals for the risk appetite and strategy for risk management such as earning-volatility targets and should review with senior management how the firm's strategy is evolving over time. Board of Directors and senior management should be actively involved in the risk control processes and must regard risk control as an essential aspect of the business to which significant resources need to be devoted. In this regard, the daily reports prepared by the independent risk control unit must be reviewed by a level of management with sufficient seniority and authority to enforce both reductions of positions taken by individual traders and reductions in bank's overall risk exposure.

Documentation of Policies, Procedures and model parameters

7.2 Banks should have a system in place for ensuring compliance with a documented set of internal policies, controls and procedures concerning the operation of the risk measurement system. The bank's risk measurement system must be well documented, for example, through a risk management manual, to describe the basic principles of risk management system and to provide empirical techniques used to measure market risk.

Maintenance of Market Risk Model Dossier

7.3 Banks that have received RBI approval for using an internal model for determining market risk capital charge should maintain, on an ongoing basis, a fully updated dossier, known as an **Market Risk Model (MRM) Dossier**, to keep a record of the details of the model and of the changes / refinements, if any, made in the model from time to time. By its nature, the MRM Dossier is not a risk manual and, to avoid duplication in its compilation, it is not necessary to incorporate the full contents of the various management and operating manuals that establish and develop the risk management and control function. A descriptive reference or link to such manuals, documents or files is sufficient for these purposes. The Dossier is meant to be the comprehensive official record / database of all aspects of the RBI-approved model being used by the bank. The dossier should include the following documents / information:

a) Full technical specifications of the model;

b) RBI approval for the model and for subsequent changes, if any, made to the model along with the conditions subject to which the approval has been granted;

c) Complete details and record of subsequent changes, if any, (such as new products covered, modifications to the scope of the model, revision of sources of external data, modifications in the applications, organisational changes, etc.) in the operation of the approved model.

The MRM Dosier should also contain, apart from the foregoing details, the following information, at the minimum, appropriately structured:

a) Authors responsible for the contents, date updated
b) Description of the scope of application of the model
c) Risk exposures and levels
d) Policies and organisation
e) Risk measurement system
f) Stress analysis programme and results of the tests
g) Back-testing programme and the results of the tests
h) Uses to which the VaR is put within the bank
i) Technological environment and information integrity controls
j) Independent assessments of the model
k) Weaknesses identified in the model and future developments planned

7.4 However, any relevant change in the model must be immediately notified to the RBI. It will not be enough in such cases to carry out the necessary updation in the Model Dossier.

Organisation of Market Risk Function of a bank

7.5 A typical organisational design of the market risk function of a bank conforming to standards of Basel II Framework for management and measurement of market risk would have the following ***independent*** elements:

(i) Front Office/Trading unit: This unit comprises the trading desks and their immediate supervisors.

(ii) Middle Office/Risk Control Unit:

a) This unit is responsible for the design and implementation of the bank's market risk management system. The unit should produce and analyse daily reports on the output of the bank's risk measurement model, including an evaluation of the relationship between measures of risk exposure and trading limits. This unit must be independent from business trading units and should report directly to senior management of the bank.

b) The unit should conduct a regular back-testing programme, i.e. an ex-post comparison of the risk measure generated by the model against actual daily changes in portfolio value over longer periods of time, as well as hypothetical changes based on static positions.

c) This unit should also conduct the initial and on-going validation of the internal model. However, the responsibilities for model construction and model validation shall be clearly and formally defined. Further, the staff performing model validation shall be independent of the staff who constructed the model (i.e. the bank shall ensure that there is no conflict of interest and that the staff performing the validation work can provide objective and effective challenge to the staff who construct the model). The guidance on the validation of the models is given in para 12.

d) The unit will also be responsible for performing stress tests on the market risk exposures of the bank.

(iii) Model Construction Unit: If a bank decides to construct the market risk model(s) in-house, it should constitute the model construction team comprising staff who are later not involved in the validation and internal audit of these models.

(iv) Model Validation Unit: This unit will comprise the suitably qualified staff who were not involved in the model development process. However, the unit may be a part of the risk control unit.

*(v) Back Office***:** This unit ensures the correct recording of transactions and funds transfers.

(vi) Internal Audit **:** An independent review of the risk measurement system should be carried out regularly in the bank's own internal auditing process. This review should include both the activities of the business trading units and of the independent risk control unit. A review of the overall risk management process should take place at regular intervals (ideally not less than once a year) and should specifically address, at a minimum:

- The adequacy of the documentation of risk management system and process;
- The organisation and functioning of the risk control unit;
- The integration of market risk measures into daily risk management;
- The approval process for risk pricing models and valuation systems used by front and back-office personnel;
- The validation of any significant change in the risk measurement process;
- The scope of market risks captured by the risk measurement model;
- The integrity of management information system;
- The accuracy and completeness of position data;
- The verification of the consistency, timeliness and reliability of data sources used to run internal models, including the independence of such data sources;
- The accuracy and appropriateness of volatility and correlation assumptions;

- The accuracy of valuation and risk transformation calculation;
- The verification of the model's accuracy through frequent back-testing as described above and in **Appendix 2.**

In view of the overarching responsibility and scope of the work of internal audit function, as described above, it would be necessary for a bank to ensure that this function is staffed with personnel possessing the required qualifications, skills and experience.

Risk Management System within the bank

7.6 Banks' internal risk measurement model must be **closely integrated** into the day-to-day risk management process of the bank. Its output should accordingly be an integral part of the process of planning, monitoring and controlling the bank's market risk profile.

7.7 The **risk measurement** system should be used in conjunction with internal trading and exposure limits. In this regard, trading limits should be related to the bank's risk measurement model in a manner that is well understood by both traders and senior management.

7.8 A routine and rigorous programme of **stress testing** should be in place as a supplement to the risk analysis based on day-to-day output of the bank's risk measurement model. The results of stress testing should be reviewed periodically by senior management, used in internal assessment of capital adequacy, and reflected in policies and limits set by management and the board of directors. Where stress tests reveal particular vulnerability to a given set of circumstances, prompt steps should be taken to manage those risks appropriately (e.g., by hedging against that outcome or reducing the size of bank's exposures, or increasing capital).

Information Technology

7.9 In assessing whether the VaR model is implemented with integrity, RBI will consider in particular the information technology systems used to run the model and associated calculations. The assessment may include an evaluation of the following systems and procedures:

a) Feeder systems; risk aggregation systems; time series databases; the

VaR Model system; stress testing system; the back-testing system including profit and loss cleaning systems where appropriate; data quality; reconciliations and checks on completeness of capture.

b) System development, change control and documentation; security and audit trails; system availability and contingency procedures; 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.

8. RISK MEASUREMENT

General

8.1 As stated in para 7.6, the bank should ensure that its market risk measurement system is comprehensive and accurate, and closely integrated with the day-to-day risk management process and system of the bank. Its output should also be an integral part of the market risk management process and system of the bank.

8.2 A bank shall have a robust model validation and internal approval process for its market risk measurement system.

8.3 The VaR-based measure calculated by the market risk measurement system shall be denominated in Indian Rupees. The measure of exposure for the purpose of computing VaR would be the market value of the position i.e. any depreciation/appreciation as on the date of computation would be taken into account while determining the market value. However, for the purpose of accounting and provisioning banks would continue to follow the existing guidelines on valuation of trading positions as contained in Master Circular on Classification, Valuation and Operation of Investment Portfolio by banks.

8.4 A bank shall relate its market risk and exposure limits to its risk measurement model in a manner that is consistent over time and that is well understood by both traders and senior management.

8.5 The Board and senior management should understand the basis of the internal models used by the bank, including their major assumptions, strengths and limitations.

8.6 The market risk measurement system should be scalable i.e., it should easily accommodate volume increases, new valuation methodologies and new products. In particular, the computer systems (both hardware and software) used should be capable of handling the volume of transactions and the complexity of market risks assumed. The bank should also consider the ease with which processing and other software errors can be corrected.

8.7 As model development and implementation is a complex process, a bank should ensure that its staff and, where applicable, its vendors and consultants have the requisite skills to manage the inherent complexity involved.

Use of Vendor Models

8.8 Vendor models would be held to the same minimum validation standards as internally developed models for valuing exposures and computing VaR. The onus of demonstrating this to the RBI will be on the bank. In cases where the bank uses a vendor-supplied model, the bank shall ensure that it obtains from the vendor and has on record the mathematical and statistical basis of the risk measurement model. The bank shall also ensure that the staff responsible for calculating the market risk capital requirements using the model understands the model including its mathematical and statistical basis and key assumptions thoroughly. In particular, where vendor models are used, the bank should:

a) document and explain the role of the vendor model and the extent to which it is used within the market risk measurement system of the bank;

b) demonstrate a thorough understanding of the vendor model;

c) ensure that the vendor model is appropriate for measuring the market risk of the bank, given the nature of the portfolio and the capabilities of the staff; and

d) have clearly described strategies for regularly reviewing the performance of the vendor model.

8.9 A bank shall not use a risk measurement model obtained from a third-party vendor that claims proprietary technology as a justification for not providing the documentation or any other details of the model to the bank. The use of such models will not be considered by the RBI as a ground for exemption from complying with the requirements of these guidelines.

Specification of market risk factors

8.10 An important part of a bank's internal market risk measurement system is the specification of an appropriate set of market risk factors, i.e., the market rates and prices that affect the value of the bank's trading positions. In other words, a risk factor is any variable which affects the value of the position. The risk factors contained in a market risk measurement system (i.e., computation of a VaR measure) should be sufficient to capture the risks inherent in the bank's portfolio of on- and off-balance sheet trading positions. Specification of the risk factors by banks for their internal models should be based on the criteria laid down in paras 8.10 to 8.13.

General Criteria

8.10.1 Factors that are deemed relevant for pricing should be included as risk factors in the VaR model. Where a risk factor is incorporated in a pricing model but not in the VaR model, the bank must justify this omission to the satisfaction of the RBI. Where any market risk factor is not captured, the bank shall document this, together with a risk estimate, and report the fact to the Board and senior management. The bank shall endeavor to capture such risk factors in the VaR model within a reasonable time.

8.10.2 In addition, the VaR model must capture non-linearities for options and all other products entailing non-linearity (e.g., mortgage-backed securities, tranched exposures or n^{th}-to-default credit derivatives). The VaR model should also capture correlation risk and basis risk (e.g., between credit default swaps and bonds), wherever overseas branches of banks have such exposures with prior permission of RBI. Moreover, wherever a proxy is used to model the risk of a particular position, the proxy must show a good record of tracking the actual position held (for example, an equity index for a position in an individual stock). The granularity and comprehensiveness of the risk factors should be commensurate with the complexity of the risks assumed by the bank.

Criteria for Interest Rate Sensitive Portfolios

8.11 For interest rate-sensitive products, the bank should meet the following criteria:

8.11.1 There must be a set of risk factors corresponding to interest rates in each currency in which the bank has interest rate sensitive on- or off-balance sheet positions. The risk factors which capture the risk in an interest rate sensitive position mainly include the changes in spot rates, both parallel and non-parallel shifts in the yield curve, changes in convexity of the curves, changes in basis, etc.

8.11.2 The risk measurement system should model the yield curve using one of the several generally accepted approaches, for example, by estimating forward rates of zero coupon yields. The yield curve should be divided into various maturity segments in order to capture variation of volatility of rates along the yield curve; there will typically be one risk factor corresponding to each maturity segment. For material exposures to interest rate movements in the major currencies and markets, banks must model the yield curve using a minimum of ***six*** risk factors. In order to achieve this, banks must divide the yield curves of, at a minimum, the major currencies and markets in which it has interest rate exposure into a minimum of six maturity segments. However, the number of risk factors used should ultimately be driven by the nature of bank's trading strategies. For instance, a bank with a portfolio of various types of securities across many points of yield curve and that engages in complex arbitrage strategies would require a larger number of risk factors to capture interest rate risks accurately.

8.11.3 The risk measurement system must incorporate separate risk factors to capture spread risk (e.g., between bond and swaps). A variety of approaches may be used to capture the spread risk arising from less-than-perfectly correlated movements between government and other fixed-income instruments (for example, for swaps) or estimating the spread over government rates at various points along the yield curve.

8.11.4 Where market rates are not reliable for particular segments of the yield curve (e.g., due to market illiquidity), a bank should make an attempt to verify the rates from other sources. For example, the bank may obtain alternative quotes to verify the primary source of the data. Alternatively, the bank may also verify the data using

statistical models or the bank may manually adjust the data if the primary source is found to be unreliable, provided that the adjustment leads to a more conservative result.

Criteria for Foreign Exchange Exposures

8.12 For foreign exchange positions (which will include gold), the risk measurement system should incorporate risk factors corresponding to each of the foreign currencies in which bank's positions are denominated. Since the VaR figure calculated by the risk measurement system will be expressed in Indian rupees, any net position denominated in a foreign currency will introduce exchange rate risk. Thus, the risk factors corresponding to the exchange rate between the domestic currency and each foreign currency in which bank has a significant exposure must be included in the model.

Criteria for Equity Exposures

8.13 For equity exposures, the following criteria should be fulfilled:

8.13.1 The general market risk in an equity position reflects the systematic risk inherent in the position. The systematic risk in equities could be modelled with a single-index or multi-factor model; the latter generally is capable of generating a better measure of risk unless the complexity of the model or the too many risk factors acts to impair the quality of the output. For an equity exposure, depending upon the availability of data, a bank could use market indices, sector indices and sub-sector indices, in conjunction with the respective security-market 'beta' /sector 'beta' /sub-sector 'beta', as the risk factors to quantify the general market risk.

8.13.2 The risk factors corresponding to each of the equity markets in which bank holds 'significant' positions should be included in the model. For this purpose, a 'significant' position would mean a position in a particular equity market amounting to more than one per cent of the bank's net worth. At a minimum, there should be a risk factor that is designed to capture market-wide movements in equity prices in each market where the bank holds positions (e.g., a market index). Positions in individual securities or in sector indices could be expressed in "beta-equivalents" relative to the market-wide index.

8.13.3 The risk factors should capture the volatility and correlation effects of each of the equity issues. Where it is not possible to have risk factors corresponding to each equity issue, the risk factors should correspond to sector- or market-wide movements in equity prices (e.g., a sector index or market index). For instance, this might happen when enough data are not available to calculate beta/market correlation of a security.

8.13.4 A somewhat more detailed approach would be to have risk factors corresponding to various sectors of the overall equity market (for instance, industry sectors or cyclical and non-cyclical sectors). As stated above, positions in individual stocks within each sector could be expressed in beta-equivalents relative to the sector index.

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

8.13.6 The sophistication and nature of the modelling techniques for a given market should correspond to the bank's exposure to the overall market as well as its concentration in individual equity issues in that market.

Method for Calculating Capital Charge for Investments in / Exposure to Mutual Funds (MFs)

8.14 For the time being, market-risk capital charge for banks' exposures to MFs should be determined by SMM.

9. MINIMUM QUANTITATIVE CRITERIA FOR VALUE-AT-RISK MODELS

General

9.1 The capital requirement under IMA would be a function of three components as indicated below :

- *Normal VaR Measure (for general market risk and specific risk)*
- *Stressed VaR Measure (for general market risk and specific risk)*
- *Incremental Risk Charge (IRC) (for positions subject to interest rate specific-risk capital charge)*

General market risk and specific risk can be modelled together or separately for normal VaR measure and stressed VaR measure. In other words, a bank could

calculate either a combined VaR measure for the two risk categories (general market risk and specific risk) or separate VaR measures for each of them. For example, as mentioned in the para 8.13.5, the most extensive approach to model equity risk would be having risk factors corresponding to the volatility of individual equity issues. In such a case, bank would have modelled both general market risk and specific risk together. However, in cases where a bank calculates a combined VaR measure, it should be able to isolate the VaR for each component so as to enable its back-testing and use in the day-to-day risk management. In addition, in the case of interest rate-sensitive positions, which have credit risk, the banks will also have to compute incremental risk charge for default and migration risks, which are generally not captured by the VaR model.

9.2 To start with, banks in India may model general market risk and use SMM for specific risk. The capital charge for market risk will be the function of the following three components:

- *Normal VaR Measure* (*general market risk*)
- *Stressed VaR Measure (general market risk)*
- *Specific Risk Charge as per the Standardised Measurement Method as prescribed in Master Circular on New Capital Adequacy Framework*

If a bank is not able to model the general market risk separately or isolate the general market risk and specific risk components, and therefore, calculates a combined VaR reflecting both general market risk and specific risk, it would still have to hold additional capital for specific risk as per SMM.

Parameters for the VaR Models

9.3 While the banks will have flexibility in devising the precise nature of their VaR models, any VaR model used must meet the minimum specifications enumerated in the following paragraphs.

9.4 Value-at-risk must be computed on a **daily basis.**

9.5 In calculating VaR, a **99th percentile, one-tailed confidence interval** is to be used.

9.6 In calculating VaR, an instantaneous price shock equivalent to a 10-day

movement in prices is to be used, i.e., the **minimum "holding period"** will be ten trading days. Banks may use VaR numbers calculated according to shorter holding periods scaled up to ten days, in an appropriate manner. Banks should use the "*square root of time rule*" only for linear portfolios with identically and independently normally distributed returns. A bank using this approach, for portfolios other than linear portfolios with identically and independently normally distributed returns, must periodically justify the reasonableness of its approach to the satisfaction of the RBI.

9.7 The choice of **historical observation period** for calculating VaR will be constrained to a minimum length of one year. For banks that use a weighting scheme or other methods for the historical observation period, the "effective" observation period must be at least one year (that is, the weighted average time lag of the individual observations cannot be less than 6 months). The RBI may stipulate the shorter time horizon for data requirement (like three months) if situation so warrants, for example, when financial markets volatilities have exhibited a major regime shift or correlations have been found to have changed significantly. A bank may calculate the VaR estimate using any alternate weighting scheme that is not fully consistent with the foregoing requirement so long as the method used results in a capital charge at least as conservative as that calculated according to this requirement.

9.8 Banks must **update their data sets** no less frequently than once every three months and should also reassess them whenever market prices are subject to material changes. This updating process must be flexible enough to allow for more frequent updates.

9.9 No particular **type of model** is prescribed for calculating the VaR-measure. So long as each model used captures all the material market risks run by the bank, banks will be free to use models based, for example, on variance-covariance matrices, historical simulations, or Monte Carlo simulations.

9.10 Banks will have discretion to **recognise empirical correlation** within broad risk categories (e.g., interest rates, exchange rates, equity prices, including option volatilities in each risk factor category). The RBI may recognise empirical correlations across broad risk factor categories only when it is satisfied that the bank's system of measuring correlations is sound and implemented with integrity.

9.11 Banks' models must accurately **capture the unique risks** associated with options within each of the broad risk categories. The criteria laid down in para 9.11.1 to 9.11.3 apply to the measurement of options risk.

9.11.1 Banks' models must capture the non-linear price characteristics i.e., gamma risk of options positions.

9.11.2 Banks are required to apply a full 10-day price shock to option positions or positions that display option-like characteristics. However, banks unable to do so immediately may adjust their capital measure for option risk through other methods, e.g., periodic simulations or stress testing but they are ultimately expected to adopt the application of full 10-day price shock.

9.11.3 Each bank's risk measurement system must have a set of risk factors that captures the volatilities of the rates and prices underlying option positions, i.e., vega risk. Banks with relatively large and/or complex options portfolios should have detailed specifications of the relevant volatilities. This means that banks should measure the volatilities of options disaggregated by different maturities.

Parameters for computing Stressed VaR

9.12 In addition to the normal VaR, a bank must also calculate a **"Stressed VaR"** measure. This measure is intended to replicate a VaR calculation that would be generated on the bank's current portfolio if the relevant market factors were experiencing a period of stress. The computation of stressed VaR should, therefore, meet the following requirements:

a) It should be based on the 10-day, 99th percentile, one-tailed confidence interval-VaR measure of the current portfolio;

b) The stressed-VaR should be calculated at least **weekly.**

c) The model inputs for the stressed VaR should be calibrated to historical data from a continuous 12-month period of significant financial stress relevant to the bank's portfolio.

Illustratively, for some portfolios, a 12-month period relating to significant losses in 2007-08 may adequately reflect a period of such stress; however, other periods relevant to its current portfolio must be considered by a bank.

d) The said period of stress will be approved by the RBI as part of its

approval for the IMA model submitted by the bank and would be regularly reviewed.

Choice of Stressed-VaR Model

9.13 As no particular model is prescribed under para 9.9 above, different techniques might need to be used to translate the model used for VaR into one that delivers a stressed VaR. For example, banks using Monte Carlo simulation should consider applying anti-thetic [1] data, or applying absolute rather than relative volatilities to arrive at an appropriate stressed VaR**.**

Calculation of VaR, Stressed VaR and Capital Requirement

9.14 VaR Measures would be calculated, on a daily basis, as the sum of (a) and (b) below:

a) ***Normal VaR*** , which is the higher of

(1) its previous day's VaR number measured according to the parameters specified in this section (VaR_{t-1}); and

(2) an average of the daily VaR measures on each of the preceding sixty business days (VaR_{avg}), multiplied by a multiplication factor (m_c).

b) ***Stressed VaR*** , which is the higher of

(1) its latest available stressed-VaR number calculated according to para 9.12 above ($sVaR_{t-1}$); and

(2) an average of the stressed VaR numbers calculated according to para 9.12 above over the preceding sixty business days ($sVaR_{avg}$), multiplied by a multiplication factor (m_s).

Therefore, the **capital requirement** 'C' is calculated according to the following formula:

$$\mathbf{C = max\ \{VaR_{t-1};\ (m_c + p_c)*VaR_{avg}\} + max\ \{sVaR_{t-1};\ (m_s + p_s)*sVaR_{avg}\}}$$

where:

m_c and m_s are the multiplication factors to be set **by the RBI** on the basis of their assessment of the quality of the bank's risk management system, subject to absolute minimum of three for both the factors; and

'p_c' and 'p_s' is the 'plus' / 'add on' factor, generally ranging from zero to one, **to be decided by the bank** based on the results of the back

[1] Banks should consider modeling valuation changes that are based on the magnitude of historic price movements, applied in both directions-irrespective of the direction of the historic movement.

testing of its VaR model, as detailed below.

9.15 The "plus"/ add on factors, p_c and p_s, are directly related to the *ex post* performance of their normal VaR models (not of the Stressed VaR model), thereby introducing a built-in positive incentive to maintain the predictive quality of the model. For determining the value of 'plus', the bank should use the back testing results of its VaR model only, not that of the Stressed VaR model. The 'plus' may, generally, range from 0 to 1 based on the outcome of back-testing, with zero implying the highest predictive quality of the model. Thus, if the back-testing results are satisfactory and the bank meets all of the qualitative standards set out above, the plus factor could be zero. The **Appendix 2** to these guidelines presents in detail the approach to be adopted for back-testing of models and for determining the 'plus' factor.

10. Additional Requirements for Treatment of Specific risk and Incremental Risk Charge (IRC)

As stated above, the capital charge for market risk would include specific-risk capital charge for interest rate-related instruments and for equity securities. As stated earlier in para 9.2, banks in India, to start with, may model general market risk for normal and stressed VaR and use SMM for specific risk. However, in due course, banks should endeavour to model specific risk and IRC. The manner in which the specific risk capital charge and IRC are to be modelled and its potential applicability in the IMA framework are set out in **Appendix 3**.

11. Stress Testing

11.1 Stress Testing is a valuable risk management tool which tries to quantify the size of potential losses under certain stress events. A stress event is an exceptional but credible event to which a bank's portfolio is exposed. A stress event may involve subjecting the risk factors to shocks which itself is extreme but plausible movement of risk factor. In this connection, banks' attention is invited to the RBI circular DBOD. No. BP.BC.101/21.04.103/2006-07 dated June 26, 2007 (and subsequent amendments as and when effected) on stress testing wherein banks were advised to put in place appropriate stress testing policies and stress test framework and also additional guidelines provided in Pillar II of Master Circular on New Capital Adequacy

Framework. The IMA-specific additional requirements are enumerated below.

11.2 Stress testing to identify events or influences that could greatly impact banks is a key component of a bank's assessment of its capital position. A bank's stress scenarios need to cover a range of factors that can create extraordinary losses or gains in trading portfolios, or make the control of risk in those portfolios very difficult. These factors include low-probability events in all major types of risks, including the various components of market, credit and operational risks. As stated earlier, the market risk capital charge under IMA includes a stressed VaR measure**.** Banks would calculate 'Stressed VaR' using the model inputs calibrated to historical data from a continuous 12-month period of significant financial stress relevant to the bank's portfolio and approved by RBI. These stressed scenarios would reflect the stresses experienced by banks' portfolios mainly in Indian markets (except in the case of foreign operations where the local stress periods would be applicable). However, these periods may not reflect the more acute stresses to which banks may be potentially exposed. Banks that use the internal models approach for meeting market risk capital requirements must have in place a rigorous and comprehensive stress testing programme to capture such potential stresses.

11.3 The stress testing programme must particularly address:

(i) concentration risk;

(ii) illiquidity of markets in stressed market conditions;

(iii) one way markets;

(iv) event and jump to default risks;

(v) non linearity of products;

(vi) deep out of the money positions;

(vii) positions subject to the gapping of prices; and

(viii) other risks that may not be captured appropriately in the VaR model (for example, recovery rate uncertainty, implied correlations and skew risk).

11.4 While the risk factors which are included in the VaR model can be stressed using the same model to evaluate their individual impact under stressed conditions, the ones which are not included in the VaR model such as those mentioned in the above paragraph will have to modelled separately under the stress testing programme. However, stress tests may also involve assessing the

impact on the entire trading book of correlated movements of different risk factors in a holistic manner. In such situations, the models used could be different from the VaR model used to calculate regulatory capital.

11.5 Bank's stress tests should be both of a quantitative and qualitative nature, incorporating both market risk and liquidity risk aspects of market disturbances. Quantitative criteria should indentify plausible stress scenarios to which banks could be exposed. Qualitative criteria should emphasise that two major goals of stress testing are to evaluate the capacity of the bank's capital to absorb potential large losses and to identify steps the bank can take to reduce its risk and conserve capital. This assessment is integral to setting and evaluating the bank's strategy and the results of stress testing should be routinely communicated to senior management and, periodically, to the bank's board of directors.

11.6 Banks have to provide information on stress testing in two broad areas based on general scenarios and specific scenarios which are discussed in paras 11.6.1 and 11.6.2 below.

General Scenarios

11.6.1 A bank should subject their portfolios to a series of simulated stress scenarios and provide RBI with the results. In generating potential stress scenarios, banks need not confine to the experience of the Indian markets alone as these may not have experienced acute stresses of the kind that have occurred in other parts of the world. Banks could stress their portfolios with the shocks of the magnitude experienced elsewhere, even when the concerned bank was never exposed to those in the past. For instance, these scenarios could include testing the current portfolio against periods of significant disturbances, of the magnitude, for example 1987 equity crash, the Exchange Rate Mechanism crisis of 1992 and 1993, the fall in the bond markets in the first quarter of 1994, the 1998 Russian financial crisis, the 2000 bursting of technology bubble or the 2007/2008 sub-prime crisis, incorporating both the large price movements and the sharp reduction in the liquidity associated with these events. A second type of scenario would evaluate the sensitivity of the bank's market risk exposure to changes in the assumptions about volatilities and correlations. Applying this test would require an evaluation of the historical range of variation for volatilities and correlations and evaluation of bank's current positions

against extreme values of the historical range. Due consideration should be given to the sharp variation that at times has occurred in matter of days in periods of significant market disturbance. For example, the above-mentioned situations involved correlations within risk factors approaching the extreme values of 1 or -1 at the height of the disturbance.

Specific Scenarios to capture the specific characteristics of portfolio

11.6.2 In addition to the above general scenarios, a bank should also develop its own stress tests which it identifies as most adverse based on the characteristics of its portfolio (e.g. problems in a key regions of the world combined with a sharp move in oil prices). Banks should provide RBI with a description of the methodology used to identify and carry out the scenarios as well as with a description of the results derived from these scenarios. The results should be reviewed periodically by senior management and should be reflected in the policies and limits set by management and the board of directors. Moreover, if testing reveals particular vulnerability to a given set of circumstances, RBI would require the bank to take prompt steps to manage those risks appropriately (e.g. by hedging against that outcome or reducing the size of exposure, augmentation of capital, etc.).

12. VALIDATION OF MODELS

Internal Model Validation

12.1.1 It is important that banks have processes in place to ensure that their internal models have been adequately validated by suitably qualified parties independent of the development process to ensure models are conceptually sound and adequately capture all material risks. This validation should be conducted when the model is initially developed and when any significant changes are made to the model. The validation should also be conducted on a periodic basis but especially where there have been any significant structural changes in the market or changes to the composition of the portfolio which might lead to the model no longer being adequate. More extensive model validation is particularly important where specific risk is also modelled and is required to meet the further specific risk criteria. As techniques and best practices evolve, banks should avail themselves of these advances.

12.1.2 However, for the present, a bank should observe the following three procedures when validating a model:

(a) review the logical and conceptual soundness;

(b) compare the model against an identical model constructed by staff independent of those who constructed the first-mentioned model or another model chosen as a benchmark; and

(c) review the back-testing done on the model, where back-testing is an appropriate validation process.

12.1.3 The responsibilities of the Model Validation Unit should include:

a) ensuring that the current systems setup is capable of supporting the models;

b) all changes made to the models being used, or to the modelling process, should be validated and approved;

c) the bank should maintain previous versions of the model being altered; and

d) models shall be subject to change-control procedures, so that computer codes cannot be changed except by authorised staff.

12.1.4 A bank shall have a model validation process which addresses three components of the model:

(a) ***a model inputs component***, which delivers data and assumptions to the model;

(b) ***a model processing component***, which encompasses the theoretical model and the computer codes which transform the model inputs into mathematical estimates; and

(c) ***a reporting component***, which translates the mathematical estimates into useful business information.

12.1.5 In validating **the model inputs component**, a bank should : –

(a) ensure that data from both internal and external sources is consistent, timely, reliable, independent and complete;

(b) have filter and inspection procedures to surface potential data errors, which shall be verified with an alternate data source;

(c) automate the extraction of data to the extent possible. As manual extraction of data is error-prone, the bank should pay more attention to validating such data;

(d) ensure that all data required for risk measurement is captured by the risk measurement model;

(e) ensure that assumptions required to model the risks involved are appropriately derived and justified, and do not underestimate risk. This may include the assumption of the normal distribution, volatility and correlation assumptions, the use of the square root of time scale from a one-day holding period to a 10-day holding period or where extrapolation or interpolation techniques are used, or the use of pricing models; and

(f) check the model's assumptions periodically, to ensure that they do not diverge from observed behaviour.

(g) Further to the regulatory back-testing programmes, testing for model validation should be carried out using additional tests, which may include, for instance:

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

(ii) Testing carried out for longer periods than required for the regular back-testing programme (e.g. 3 years). The longer time period generally improves the power of the backtesting. A longer time period may not be desirable if the VaR model or market conditions have changed to the extent that historical data is no longer relevant;

(iii) Testing carried out using confidence intervals other than the 99 percent interval for general market risk and 99.9 per cent for IRC required under the quantitative standards;

(iv) Testing of portfolios below the overall bank level.

12.1.6 In validating the **model processing component**, a bank should: –

(a) validate all models, whether they are purchased from a vendor or developed in-house, to ensure the accuracy of valuation and risk factor calculations. The bank should not rely solely on a model validation done by the vendor;

(b) apply the same validation principles to all models;

(c) apply procedures to test the programmed model and the mathematics used against the functional specifications of the model; and

(d) use hypothetical portfolios to ensure that the model is able to account for structural features which may arise, including:–

(i) where the bank maps positions to proxy data, ensuring that the proxy data produces conservative results under relevant market scenarios;

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

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

12.1.7 One way of testing a model could be by comparing the results of the model against those of an identical model which is independently constructed (i.e. the two models should be constructed by separate parties). If the model is working as expected, the results of the two models would coincide.

12.1.8 If independent construction of an identical model cannot be done, a bank should compare model results to the results of a "benchmark" model which has already been validated. The bank should identify a suitable "benchmark" model and ensure that the model inputs and theory of the benchmark model are similar to the bank's model according to its analysis.

12.1.9 In validating the **reporting component**, a bank should: –

(a) validate the reports in view of their context. Senior management should understand the context in which the model results are generated; and

(b) have a system of checks to ensure that the flow of information from the model outputs to the final production of the reports is error-free.

External Validation

12.2 Banks may consider validation of their models' accuracy by external auditors which should at a minimum include the steps enumerated in paras 12.2.1 to 12.2.5.

12.2.1 It should be verified that the internal validation processes described in paragraphs 7.5 and 12.1 are operating in a satisfactory manner.

12.2.2 It should be ensured that the *formulae* used in the calculation process as well as for the pricing of options and other complex instruments are validated by a Risk Control Unit, which in all cases should be independent from the trading area.

12.2.3 It should be checked that the *structure* of internal models is adequate with respect to the bank's activities and geographical coverage.

12.2.4 Results of the banks' *back-testing* of its internal measurement system (i.e. comparing VaR estimates with actual profits and losses) should be checked to ensure that the model provides a reliable measure of potential losses over time. This means that banks should make the results as well as the underlying inputs to their VaR calculations available to their supervisory authorities and/or external auditors on request.

12.2.5 It should be ensured that data flows and processes associated with the risk measurement system are transparent and accessible to the internal and external auditors and the RBI so that they are able to have easy access to the models' specifications and parameters.

Documentation supporting application to RBI for approval of Models

12.3 Along with the application for migrating to IMA, banks will have to provide a report whose content is detailed in the application file for internal market risk models, known as the MR File. This will describe implementation of internal model and the risk-management control system established, and will also substantiate compliance with the quantitative and qualitative requirements of these guidelines.

12.4 The analysis of the documentation provided in the MR File, the contents of which are described in **Appendix 4** will permit an initial assessment of whether the model proposed forms part of an integrated system for the measurement, management and control of market risk, and whether it is applied effectively and consistently in the daily management of this risk.

Model Validation by RBI

12.5 As mentioned in para 2.1, banks desirous of moving to IMA should first give RBI a notice of intention for the same. Once, a bank is allowed to make a full fledged

request for migrating to IMA, RBI will perform a detailed analysis of its model with a view to validate it.

12.6 The validation of models' accuracy by RBI, in addition to the standards indicated in para 12.2 above, will at minimum include the following steps:

a) Assessment and adequacy of documentation
b) Assessment of scope of the model
c) Qualitative review
d) Assessment of technological environment and of information integrity
e) Quantitative review

a. Analysis of documentation

The information obtained from the banks as per **Appendix 4** along with any additional information that may be necessary will be analysed by the RBI to evaluate whether it is reasonable to start the validation process. RBI will also identify the critical aspects of the model proposed by the bank based on the analysis of the documentation provided.

b. Assessment of the model's scope

RBI will assess the scope of model's implementation within the bank. Once the proposed scope of the model is known, the next steps are to assess the reasonableness of possible exclusions of some products, activities or companies of the consolidated group which, in principle, should form part of the model's potential scope and to analyse whether the model caters to effective management of actual operations subject to market risk.

Once the model's scope has been determined, its suitability will be determined in terms of:

i. Whether the instruments covered by the model meet the requirements of these guidelines, verifying that no positions or portfolios representing trading activity and should be a part of HFT, have been excluded from the model.

ii. Whether the market risk measurement methodology used is appropriate in light of the type of operations conducted.

c. Qualitative review

(i) Assessment of policies on risk management, organisation and procedures

The management policies in place will depend on the type and level of activity, the environment, the culture and the degree of risk appetite of each institution. At a minimum, the policies on the operational framework of treasury operations and of the market risk management and control function should be approved by the Board and adequately documented, including, most notably, the following:

a) Organisation of the treasury operations business and definition of the authorized strategies.
b) Objectives of market risk management (to limit losses, optimise risk-adjusted returns, efficiently allocate economic capital, etc.)
c) New product approval processes.
d) Position reassessment policies.
e) Organisational structures, delimitation of responsibilities and segregation of functions among the various units involved.
f) Delimitation of assumable risk levels, risk control procedures and treatment of possible amounts drawn in excess of overdraft limits.
g) Risk measurement systems and methodology, and stress analysis and model accuracy verification programmes.
h) Risk level communication and information system.
i) Details of price and information integrity control procedures.
j) Internal control and validation functions.
k) Internal audit action plans.

(ii) Assessment of organisational structure

The organisational structure will be assessed both functionally and hierarchically, in regard to its suitability for the operations carried out, looking at whether functions are appropriately segregated with precisely delimited duties and responsibilities, and the degree of board and senior management involvement. The assessment of control procedures focuses, in general, on ensuring the quality and integrity of product and portfolio assessments and of market risk measurements.

(iii) Assessment of uses of the model and of its integration in risk management

The internal risk management model and the VaR estimates should be integrated in

day-to-day risk management, i.e. they should pass the “use test”. Their uses will thus be reviewed, particularly in the following respects:

a) The use of VaR estimates within the bank.

b) Setting of VaR limits for market operations.

c) Allocation of capital based on VaR.

d) Assessment of risk adjusted earnings.

e) Product pricing, incorporating the level of risk assumed.

f) Contingency plans in addition to those meant for crisis situations, vis-a-vis the respective trigger events (such as draw downs in excess of overdraft limits, predefined market volatility limits, etc.) and envisaged actions (close-out of positions, specific hedges, etc.).

(iv) Analysis of internal audit reports

The internal audit reports analysing the basic aspects of the internal risk measurement and management model will be reviewed. The minimum content of the internal audit report is set out in para 7.5 above.

d. Assessment of technological environment and of information integrity

Once the Information Technology (IT) applications involved in the risk management process (trading room systems, market input value application, product and portfolio valuation applications, risk measurement applications, etc.) have been identified by the RBI, a review will be made of the information flows between applications, their periodicity and the transmission method (automatic or manual). Once the technological environment is known, the periodic tests conducted regularly by the bank to assure integrity of the information on positions included in the model, the review will cover the following:

i. Reconciliations

ii. formal procedures for periodic identification of portfolios within the model’s scope and of those excluded from it.

iii. procedures for inclusion of new portfolios or new products.

iv. daily analyses of changes in estimated risk levels and in position sensitivities, etc.

e. *Quantitative review*

(i) Assessment of measurement system

The RBI's assessment of the system used to measure market risk will basically include the following broad elements:

Model input values:

- *Quantitative requirements for parameters*: review of the historical observation period for risk factors, of the time horizon for holding portfolios and of the confidence levels used.

- *Market risk factors*: review of the reliability and independence of data sources (interest rates, exchange rates, equity prices, etc.) used to supply information on risk factor levels and changes therein. Review of the secondary calculations made using direct market information (estimation of zero-coupon curves, estimation of illiquid asset prices, rates and volatilities).

- *Position input values*: review of the criteria for measuring risk positions held and for including them in the risk measurement system.

(ii) Review of the essential features of the model methodology and of the technical details of its implementation

- Risk factors considered by the model, with special reference to the treatment of products with non-linear risks.

- Technical aspects of the methodology used (parametric approximation, simulation, etc.)

- Criteria for aggregating the risks of the various units or portfolios (aggregation of position input values or aggregation of risk estimates, verifying, in this case, the criteria and assumptions applied).

- Measurement of the specific risk associated with private debt securities and with equity securities.

(iii) Analysis of model accuracy (back-testing)

The accuracy of the internal risk model will be checked through back-tests in which the actual earnings recorded are compared with the risk predictions estimated using VaR methodology.

The accounting profit and losses include, in addition to the daily impacts of market variations on the positions held, the result of intraday deals (not included in VaR estimates on the portfolios at the close of each session) and other regular income (or expenses) from operations (fees and commissions, sales margin, etc.). To enable

comparison on an equal footing, the “clean” back-tests will be reviewed to obtain the hypothetical earnings arising from re-measurement of the positions that generated the VaR estimate (at time t_0) at market prices at the end of the time horizon of the risk estimates (generally at time t_1). Thus, the hypothetical net profits or losses obtained are expressed on a comparable basis with the VaR estimates.

Back-testing will yield the number of exceptions (number of times that the hypothetical losses exceed the VaR estimates), which, at the confidence level adopted, will be indicative of the quality of the model.

Briefly, the review of the back-testing programmes will cover the following:

- Types of back-tests conducted and criteria for constructing the earnings used in these tests. The back-tests must be “clean” and the results used will be obtained by full revaluation.
- Level of disaggregation of the back-tests.
- Internal procedures in place: periodicity of the tests conducted, analysis of exceptions (reasons for them and products or units that generated them), observation period, etc.
- Additional analyses of the calculations of exceptions established in the back-testing programmes (checks of the probability covered by the model, check of the symmetry of exceptions, check of the normality of results, size of exceptions, time distribution of exceptions, etc.)
- Internal procedures for implementing model corrective measures suggested by the back-testing programmes conducted.

As a supplement to the back-testing programmes, a review will be conducted of the internal validation procedures established to check the known limitations of the model or of the assumptions made in implementation (valuation models used, normality of yields, suitability of possible use of the statistical technique based on the square root of time to extrapolate the overnight VaR to the regulatory time horizon, suitability of the extrapolation techniques or association techniques, etc.).

(iv) Assessment of stress-testing programme

The VaR estimates, which reflect possible losses under normal market conditions, should be supplemented by the banks by estimates of profit or loss in crisis scenarios that represent extreme or unlikely but plausible situations. Basically, the

following aspects of the stress-testing programmes in place will be reviewed by the RBI:

- Scenarios considered: Irrespective of how they are formulated (through hypothetical scenarios or by replicating market movements recorded in historical crises), the selection of scenarios should be suitable for the operations in question and address events that could cause significant losses.

- Analysis and impact of worst-case scenarios and of extreme market movements.

- Inclusion of aspects of the risk that have not been efficiently captured in VaR measurements (possible liquidity difficulties of certain positions, concentration effects, volatility smiles, event and default risk, etc.).

- Frequency of calculation, and use and distribution of stress analyses, verifying that those analyses are a customary measurement forming part of the day-to-day risk management.

- Contingency plans established for management of crisis situations.

Model Monitoring

12.7 Any modifications proposed to be made to essential parameters of the model or of the risk management system (methodology changes, scope modifications due to inclusion or exclusion of certain activities, business units, etc.) should be communicated in advance to the RBI for concurrence or approval where necessary. Substantial modifications to the model would require a fresh validation process to be started by the RBI.

13. ADDITIONAL PILLAR II REQUIREMENTS APPLICABLE TO IMA

Policies and procedures for trading book eligibility

13.1 While the guidelines are applicable only to HFT portfolio of banks, the banks should put in place clear policies and procedures used for determining the exposures that may be included in, excluded from, the trading book for purposes of calculating regulatory capital and are critical to ensuring the consistency and integrity of banks' trading book.

Valuation

13.2 Banks' attention is invited to the Master Circular on New Capital Adequacy Framework. Banks should ensure compliance with the prudent valuation guidelines contained therein.

Stress testing under the internal models approach

13.3 A bank must ensure that it has sufficient capital to meet the minimum capital requirements set out in the guidelines on IMA. The RBI will examine under Supervisory Review and Evaluation Process whether a bank has sufficient capital for these purposes, taking into account the nature and scale of the bank's trading activities and any other relevant factors such as valuation adjustments made by the bank. To the extent that there is a shortfall, or if the RBI is not satisfied with the premise upon which the bank's assessment of internal market risk capital adequacy is based, it will take appropriate measures. This will usually involve requiring the bank to reduce its risk exposures and/or to hold an additional amount of capital, so that its overall capital resources at least cover the Pillar 1 requirements plus the result of a stress test acceptable to the RBI.

14. ADDITIONAL DISCLOSURES UNDER PILLAR III

The following Table would be added as an additional disclosure requirement for IMA banks under Pillar III. It would appear as **Table DF 8a** in the Pillar III disclosures presently required in terms of the updated Master Circular on New Capital Adequacy Framework.

Market risk: Disclosures for Banks Using the Internal Models Approach (IMA) for Trading Portfolios

Qualitative Disclosures	(a) The general qualitative disclosure requirement for market risk including the portfolios covered by the IMA. In addition, a discussion of the extent of and methodologies for compliance with the "Prudent valuation guidance" for positions held in the trading book (b) The discussion should include an articulation of the soundness standards on which the bank's internal capital adequacy assessment is based. It should also include a description of the methodologies used to achieve a capital adequacy assessment that is consistent with the soundness standards.

	(c) For each portfolio covered by the IMA: • the characteristics of the models used; • a description of stress testing applied to the portfolio; and • a description of the approach used for back-testing / validating the accuracy and consistency of the internal models and modelling processes. (d) The scope of acceptance by the RBI.
Quantitative Disclosures	For trading portfolios under the IMA: • The high, mean and low VaR values over the reporting period and period-end; • The high, mean and low stressed-VaR values over the reporting period and period-end; and • A comparison of VaR estimates with actual gains/losses experienced by the bank, with analysis of important "outliers" in back-test results.

15. COMPUTATION OF ELIGIBLE CAPITAL FOR MARKET RISK

15.1 Once a bank has calculated the capital charge for market risk, it has to notionally multiply this with (100÷9) to arrive at the value of the Risk Weighted Assets for market risk.

15.2 In calculating the eligible capital for market risk, the bank should first calculate the banks' minimum capital requirement for credit and operational risk and only thereafter its market risk capital requirement to establish how much Tier 1 and Tier 2 capital is available to support market risk. Eligible capital will be the sum of the whole of bank's Tier 1 capital plus all of Tier 2 capital, provided the Tier 2 capital does not exceed 100% of the Tier 1 capital and the relevant conditions for Tier 1 and Tier 2 capital are fulfilled, as enumerated in Master Circular on New Capital Adequacy Framework (NCAF).

Illustrative computation of capital for Market Risk (in Rs. crore)

1	Capital funds • Tier 1 capital ---------- • Tier 2 capital ----------	 55 50	105
2	Total risk weighted assets • RWA for credit and operational risk ---------- • RWA for market risk ----------	 1000 140	1140
3	Total CRAR		9.21
4	Minimum capital required to support credit and operational risk (1000*9%) • Tier 1 - 45 (@ 4.5% of 1000) ---------- • Tier 2 - 45 (@ 4.5% of 1000) ----------	 45 45	90
5	Capital available to support market risk (105 - 90) • Tier 1- (55 - 45) ---------- • Tier 2 - (50 - 45) ----------	 10 5	15

The total of eligible capital (Tier 1 and Tier 2) will be divided by the total RWA (credit risk+ operational risk+ market risk) to compute CRAR for the bank as a whole.

APPENDIX 1
(cf. para 3.2)

A brief description of various components of market risk

GENERAL MARKET RISK

This is the risk arising from movements in the general level of underlying risk factors such as interest rates, exchange rates, equity prices, etc.

SPECIFIC RISK

This is the risk of adverse movement in the price of individual security resulting from factors related to the security's issuer. Specific risk is further divided into four components explained below.

Default Risk

This means the potential for direct loss due to an obligor's default as well as the potential for indirect losses that may arise from a default event.

Credit Migration Risk

This is also called event risk or downgrade risk. This means the potential for direct loss due to an internal/external rating downgrade or upgrade as well as the potential for indirect losses that may arise from a credit migration event.

Credit Spread Risk

Credit spread risk arises from the possibility that changes in credit spreads will affect the value of financial instruments. Credit spreads represent the credit risk premiums required by market participants for a given credit quality, i.e., the additional yield that a debt instrument issued by an 'AA' rated entity must produce over a risk-free alternative (e.g., Government of India bond). For instance, widening of credit spread of a given credit quality (e.g. 'A' rating) due to change in perception of the credit worthiness of the issuer or liquidity of the position would lead to mark to market losses for the long position.

Incremental Risk

This is the risk not captured by the VaR-based estimate of specific risk and the

Incremental Risk Charge (IRC) is intended to complement standards being applied to value-at-risk modelling framework. IRC represents an estimate of the default and migration risks to the extent these are not captured by the VaR-based measure incorporating specific risk.

APPENDIX 2
(cf. para 9.15)

GUIDELINES FOR DESIGNING A BACK-TESTING PROGRAMME UNDER IMA

1. INTRODUCTION

This appendix is based on the framework developed by Basel Committee on Banking Supervision for incorporating backtesting into the internal models approach to market risk capital requirements. Back-testing typically consists of a periodic comparison of the bank's daily value-at-risk measures with the subsequent daily profit or loss ("trading outcome"). The value-at-risk measures are intended to be larger than all but a certain fraction of the trading outcomes, where that fraction is determined by the confidence level of the value-at-risk measure. Comparing the risk measures with the trading outcomes simply means that the bank counts the number of times that the risk measures were larger than the trading outcome. The fraction actually covered can then be compared with the intended level of coverage to gauge the performance of the bank's risk model.

2. CONFIDENCE LEVELS AND HOLDING PERIOD FOR BACK-TESTING

2.1 In accordance with Basel II requirements, back- testing will be based on 1 per cent daily VaR estimate i.e. holding period will be assumed as one day and it will cover a period of 250 days. Although capital requirement is based on 10-trading day holding period assumption, the requirement for back-testing has been set as one day VaR. This is based on the assumption that it might be difficult for a bank to perform back-testing based on 250 non-overlapping 10-days returns, since the data requirements may be quite huge for the back test to have certain level of accuracy.

2.2 While back-testing of 1% VaR is required to establish the accuracy of the model for the purpose of capital adequacy, in order to dynamically verify model assumptions, banks may, in addition, back-test VaR models based on 2%, 5% and 10% VaR. A 95% daily confidence level is generally considered practical for back-testing because one should observe roughly one excession a month (one in 20 trading days). A 95% VaR represents a realistic and observable adverse move. A higher confidence level, such as 99%, means that we would expect to observe an exceedence only once in 100 days, or roughly 2.5 times a year. Verifying higher

confidence levels thus requires significantly more data and time.

3. ACTUAL AND HYPOTHETICAL TRADING OUTCOMES

3.1 The value-at-risk approach to risk measurement is generally based on the sensitivity of a static portfolio to instantaneous price shocks. That is, end-of-day trading positions are input into the risk measurement model, which assesses the possible change in the value of this static portfolio due to price and rate movements over the assumed holding period. However, in practice it complicates the issue of back-testing. Firstly, actual trading outcomes are inevitably "contaminated" by changes in portfolio composition during the holding period. Secondly, the P&L also includes fees and other expenses, in addition to changes in P&L due to market movements. This requires exclusion of fee income together with trading gains and losses resulting from changes in the composition of the portfolio from the definition of the trading outcome because they do not relate to the risk inherent in the static portfolio that was assumed in constructing the value-at-risk measure. This becomes all the more important with regard to the use of value-at-risk measures based on price shocks calibrated to longer holding periods (10-day for the purpose of capital adequacy). That is, comparing the ten-day, 99th percentile risk measures from the internal models capital requirement with actual ten-day trading outcomes would probably not be a meaningful exercise, as the portfolio composition would have changed significantly during the holding period.

4. ADDRESSING THE CONTAMINATION DUE TO CHANGES IN PORTFOLIO

The issue of changes in portfolio composition during the holding period of 10-days would be addressed to a great extent as the banks would back-test VaR with 1 day holding period, as indicated in para 2 above. Given the use of one-day risk measures, it will be appropriate to employ one-day trading outcomes as the benchmark to use in the back-testing program. The same concerns about "contamination" of the trading outcomes discussed above continue to be relevant, however, even for one-day trading outcomes. However, the effects would be much less.

5. ADDRESSING THE CONTAMINATION DUE TO FEES ETC.

Since the fee income is not typically included in the calculation of the risk measure, problems with the risk measurement model could be masked by including fee income in the definition of the trading outcome used for back-testing purposes. The issue of fee income can be addressed sufficiently, albeit crudely, by simply removing the mean of the trading outcomes from their time series before performing the back-tests. A more sophisticated approach would involve a detailed attribution of income by source, including fees, spreads, market movements, and intra-day trading results.

6. BACK-TESTING USING ACTUAL DAILY PROFITS AND LOSSES

There is a view that the actual trading outcomes experienced by the bank are the most important and relevant figures for risk management purposes, and that the risk measures should be benchmarked against this reality, even if the assumptions behind their calculations are limited in this regard. Thus, back-testing using actual daily profits and losses is also a useful exercise since it can uncover cases where the risk measures are not accurately capturing trading volatility in spite of being calculated with integrity. For these reasons, *banks are encouraged also to develop the capability to perform back-tests using actual trading outcomes*. In combination, the two approaches are likely to provide a strong understanding of the relation between calculated risk measures and trading outcomes.

7. FREQUENCY OF BACK-TESTING

Banks should perform back-testing of the VaR-models for each of major risk categories separately wherever VaR for all major risk categories is computed separately. Banks should also perform back-testing of overall VaR, in case risk aggregation across all major risk categories has been done. Banks should account for exceptions at least on a quarterly basis, but preferably on a monthly basis, using the most recent twelve months of data. The implementation of the back-testing program should begin at least six months before the date the bank makes an application to RBI for approval of the model. In addition, the model should also be back-tested at least for two quarters post-RBI approval, before it is actually used for calculating regulatory capital.

8. USE OF STATISTICAL MODELS TO TEST THE ACCURACY OF THE VaR MODELS

Banks are encouraged to use statistical tools to test the accuracy of the VaR Models. In due course, RBI would examine admission of these tools as an evidence of accuracy in conjunction with the "exceptions-based rule" prescribed in accordance with Basel-II Framework.

9. SUPERVISORY FRAMEWORK FOR THE INTERPRETATION OF THE BACK-TESTING RESULTS

A bank will classify its back-testing outcomes into the following three zones depending on the number of exceptions arising from back-testing:

9.1 If the back-testing results produce four or fewer exceptions, it falls within the Green Zone and there may not be any increase in the multiplication factor beyond minimum three for both VaR and stressed VaR as mentioned in the para 9.15 of these guidelines.

9.2 If the back-testing results produce five to nine exceptions, it falls within the Yellow Zone and there would be an increase in the multiplication factors for both VaR and stressed VaR as mentioned in the Table below.

9.3 If the back-testing results produce ten or more exceptions, it falls within the Red Zone and the multiplication factors for both VaR and stressed VaR will be increased from three to four. RBI will allow 10 or more exceptions under the most extraordinary circumstances. RBI may require banks whose model for market risk fall in Red Zone to either discontinue the model or begin work on improving the model immediately. RBI may also consider further increase in the capital requirements if the bank is not able to demonstrate that its models are capturing all market (general market risk and specific risk, if any) risks it is exposed to.

Zone	Number of Exceptions	Increase in multiplication factor
Green Zone	0	0.00
	1	0.00
	2	0.00
	3	0.00
	4	0.00
Yellow Zone	5	0.40
	6	0.50
	7	0.65
	8	0.75
	9	0.85
Red Zone	10 or more	1.00

10. EXPLANATIONS FOR BACK-TESTING EXCEPTIONS

There may be several possible explanations for a back-testing exception. Banks will classify the exceptions generated by their model out of back-testing exercise into the categories enumerated in paras 10.1 to 10.4 below.

10.1 BASIC INTEGRITY OF THE MODEL

- The bank's systems are not simply capturing the risk of the positions themselves.
- Model volatilities and/or correlations were calculated incorrectly.

The problems related to the basic integrity of the risk measurement models are potentially the most serious. If there are exceptions attributed to this category for a particular trading unit, there may be need to necessarily increase the multiplication factor. In addition, the model may be in need of substantial review and/or adjustment, and RBI will take appropriate action to ensure that this occurs.

10.2 MODEL'S ACCURACY COULD BE IMPROVED

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).

This problem (lack of model precision) is one that can be expected to occur at least part of the time with most risk measurement models. No model can hope to achieve infinite precision, and, thus all models involve some amount of approximation. If, however, a particular bank's model appears more prone to this type of problem than others, the RBI may increase the multiplication factors and also take appropriate action to ensure that improvements in the model's accuracy are ensured.

10.3 BAD LUCK OR MARKETS MOVED IN FASHION UNANTICIPATED BY THE MODEL

- Random chance (a very low probability event).
- Markets moved by more than the model predicted was likely (i.e. volatility was significantly higher than expected).
- Markets did not move together as expected (i.e. correlations were significantly different than that was assumed by the model).

This category of problems (markets moved in a fashion unanticipated by the model) should also be expected to occur at least some of the time with the value-at-risk models. No value-at-risk 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.

10.4 LOSS DUE TO INTRA-DAY TRADING

There was a large (and money-losing) change in the bank'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 the trading results were tabulated).

11. REPORTING OF BACK-TESTING RESULTS TO BOARD

On a quarterly basis or more frequently (if back-testing is done more frequently), a bank shall analyse the back-testing exceptions for each of the risk categories and also for the aggregate VaR, in case computed using a model, and submit a report to Board, incorporating an analysis of the back-testing results including classification of exceptions and any implications for the bank. The results of back-testing and any follow-up action taken shall be clearly documented. All back-testing exceptions, i.e. where trading outcomes are not covered by the risk measure, shall be investigated and explained on a timely basis.

12. REPORTING OF BACK-TESTING RESULTS TO RBI AND SUPERVISORY RESPONSE

12.1 A bank should also report to the RBI (Chief General Manager-in-Charge, Department of Banking Supervision, Central Office) the results of their back-testing exercise every quarter before the last day of the month following the close of reporting quarter. In addition to exceptions, the report should include:

i. The classification of exceptions and possible explanations for the same.
ii. The proposed investigations, if not already completed.
iii. Action already taken or proposed to be taken to improve the performance of the model.
iv. Number of exceptions observed during each of the last three back-testing results excluding the one under reporting.

12.2 Using the most recent twelve months of data yields approximately 250 daily observations for the purposes of back-testing. Although results within the **Green Zone** are preferred, a market risk measurement model which constantly yields little or no back-testing exceptions may suggest that the model is too conservative. If the model shows no exceptions for long periods of time, the bank should reassess its model to determine if it overstates risk.

12.3 If a bank has reason to believe that its model is robust in spite of the back-testing results falling within the **Yellow Zone**, it may apply for the approval of the RBI to waive the requirement to increase capital. RBI will consider a waiver only if the bank can demonstrate that its model is robust, and that the back-testing exceptions are caused purely by the outliers in market data. If the back-testing results continuously fall in the yellow zone for more than three quarters, no waiver shall be considered and the bank has to apply the higher multiplication factor as per table given above.

12.4 If the results fall in the **Red Zone**, the bank should automatically apply the higher multiplication factor. No representation for waiver shall be entertained in such cases. In addition, RBI would initiate a dialogue with the bank to determine the problems with the bank's model and in the most serious cases, RBI may impose a further increase in a bank's capital requirement or disallow use of the model altogether.

APPENDIX 3
(cf. para 10)

GUIDELINES FOR BUILDING SPECIFIC RISK AND INCREMENTAL RISK CHARGE (IRC) MODELS

1. SPECIFIC RISK

1.1 For an equity exposure, specific risk represents the idiosyncratic risk that is unrelated to the overall market movement. For interest rate instruments, the specific risk factors may be categorised as those contributing to spread risk, event risk and default risk, as defined in **Appendix 1**. As stated in para 9.1 of the guidelines, the specific risk can be modelled either along with the general market risk or separately. From a regulatory perspective, an ideal specific risk model not only incorporates all component of specific risk, but also attributes the overall measure of the specific risk to its individual components. Under the IMA, banks may not be able to capture the entire default risk and migration risk in the VaR-measure. In such cases, banks will have to assign Incremental Risk Charge (IRC).

Specific Risk in Equity Positions

1.2 Where a bank has a VaR measure that incorporates specific risk for equity positions and where the RBI has determined that the bank meets all the qualitative and quantitative requirements of these guidelines regarding computation of VaR measures and also the conditions below, the bank will not be required to determine the specific risk capital charge as per SMM. Banks which are unable to meet these requirements for modelling of specific risk for equity positions, should compute their specific risk capital charge at 9 per cent of gross equity positions according to the SMM.

Specific Risk in Interest Rate Positions

1.3 The banks adopting IMA will not be required to determine the capital charge for specific risk for their interest ***rate risk positions*** other than securitisation exposures, under the SMM when the following two conditions are satisfied.

a) The bank has a VaR measure that incorporates specific risk and RBI has determined that the bank meets all the qualitative and quantitative requirements of these guidelines regarding computation of VaR

measures as given in the guidelines and the conditions in para 1.5 below.

b) The RBI is satisfied that the bank's internally developed approach adequately captures incremental default and migration risks for positions subject to specific interest rate risk according to the standards laid out in these guidelines.

1.4 It may be noted that it is not intended that the banks should cover their securitisation exposures under the IMA for computing specific risk capital charge and the banks are required to determine this capital charge under the SMM only, even if they adopt IMA. Thus, even if a bank adopting IMA is allowed to include its securitisation exposures in its VaR measure for determining the specific-risk capital charge, it will not be exempted from maintaining capital for such exposures under the SMM and will still be required to hold additional capital for specific risk for these exposures according to the SMM.

Additional Criteria for Modelling of Specific Risk

1.5 The criteria for supervisory recognition of banks' modelling of specific risk require that a bank's model must capture all material components of price risk and be responsive to changes in market conditions and compositions of portfolios. In particular, the model must meet the standards enumerated in paras 1.5.1 to 1.5.10.

1.5.1 The model should be able to explain the historical price variation in the portfolio. The key *ex ante* measures of model quality are "goodness-of-fit" measures which address the question of how much of the historical variation in price value is explained by the risk factors included within the model. As stated above, the specific risk component measures the non-systematic part of the risk. In order to have a reliable isolation of specific risk component, it is necessary that the factor(s) used to represent the systematic part of the risk explain a high percentage of price variation and the residual variability representing the specific risk is minimised. One measure of this type which can often be used is an R-squared measure from regression methodology. If this measure is to be used, the risk factors included in the bank's model would be expected to be able to explain a high percentage, such as 90%, of this historical price variation or the model should explicitly include estimates of residual variability not captured in the factors included in this regression. For some type of models, it may not be feasible to calculate a goodness-of-fit measure. In such

an instance, the RBI will assess the details of the model and define an acceptable alternative measure which would meet this regulatory objective.

1.5.2 The model should be able to capture concentrations (magnitude and changes in composition). The bank would be expected to demonstrate that the model is sensitive to changes in portfolio construction and that higher capital charges are attracted for portfolios that have increasing concentrations in particular names or sectors.

1.5.3 The model should be robust to an adverse environment. The bank should be able to demonstrate that the model will signal rising risk in an adverse environment. One approach for demonstrating this would be incorporating in the historical estimation period of the model at least one full credit cycle and ensuring that the model is accurate throughout the cycle. Another approach for demonstrating this is through simulation of historical or plausible worst-case environments. In assessing the model's robustness, RBI would consider the testing of the model by the bank, including regression analysis, stress testing, the scope of testing, the number of tests completed and the results of these tests. If the results are unclear, or the testing of the model by the bank is deemed insufficient to conclude that the model is robust, the bank shall address these concerns before approval of the model is granted.

1.5.4 The model should be able to capture name-related basis risk. The bank should be able to demonstrate that the model is sensitive to material idiosyncratic differences between similar but not identical positions, for example, debt positions with different levels of subordination and maturity mismatches.

1.5.5 The model should be able to capture event risk. For debt positions, this should include migration risk. For equity positions, events that are reflected in large changes or jumps in prices must be captured, e.g. merger break-ups/takeovers.

1.5.6 The model should be validated through back-testing. Banks which apply modelled estimates of specific risk are required to conduct back-testing aimed at assessing whether specific risk is being accurately captured. The methodology a bank should use for validating its specific risk estimates is to perform separate back-tests on sub-portfolios using daily data on sub-portfolios subject to specific risk. The

key sub-portfolios for this purpose are traded debt and equity positions. However, if a bank itself decomposes its trading portfolio into finer categories (e.g. traded corporate debt, structured securities etc.), it is appropriate to keep these distinctions for sub-portfolio back-testing purposes. Banks are required to commit to a sub-portfolio structure and stick to it unless it can be demonstrated to the RBI that it would make sense to change the structure.

1.5.7 Banks are required to have in place a process to analyse exceptions identified through the back-testing of specific risk. This process is intended to serve as the fundamental way in which banks correct their models of specific risk in the event they become inaccurate. There will be a presumption that models that incorporate specific risk are "unacceptable" if the results at the sub-portfolio level produce a number of exceptions commensurate with the *Red Zone* as defined in **Appendix 2** of this Framework. Banks with "unacceptable" specific risk models are expected to take immediate action to correct the problem in the model and to ensure that there is a sufficient capital buffer to absorb the risk that the back-test showed had not been adequately captured.

1.5.8 The bank's model must conservatively assess the risk arising from less liquid positions and/or positions with limited price transparency under realistic market scenarios. In addition, the model must meet minimum data standards. Proxies may be used only where available data are insufficient or are not reflective of the true volatility of a position or portfolio, and only where they are appropriately conservative. Where the RBI considers that limited liquidity or price transparency undermines the effectiveness of a bank's model to capture specific risk, it will take appropriate measure, including the exclusion of position from the bank's specific risk model, and placing it under specific risk SMM.

1.5.9 All components of **specific risk** would be considered under the IMA in respect of securities of foreign central government rated below AA. No components of credit risk is required to be modelled in respect of investment in GoI securities.

1.5.10 While banks may use credit spreads published by an external agency such as FIMMDA for the purpose of valuation and modelling of specific risk, they should continue to make efforts to obtain their own measure of credit spreads.

2. INCREMENTAL RISK CAPITAL CHARGE

2.1 As stated in para 9.1 of the guidelines, banks which use VaR-models to measure specific risk in interest rate instruments, must assign capital for "incremental risks" i.e. default and migration risks to the extent these are not covered in the VaR-measure. Therefore, a bank must have an approach in place to capture in its regulatory capital the incremental risks, with the exception of securitisation exposures. No specific approach for capturing the incremental risks is prescribed.

2.2 The bank must demonstrate that the approach used to capture incremental risks meets a high level soundness standard to the satisfaction of RBI, under the assumption of a constant level of risk, and adjusted where appropriate to reflect the impact of liquidity, concentrations, hedging, and optionality. A bank that does not capture the incremental default risks through an internally developed approach must use the specific risk capital charges under the SMM.

2.3 Inability of banks to comply with the conditions specified for modelling of specific risk including IRC would mean that they will have to continue to follow the standardised measurement method for calculating specific risk capital charge. However, banks should continue to make efforts to comply with these conditions and develop ability to model the specific risk including 'incremental risks' so as to achieve a better measure of specific risk for allocating capital. This would be taken into consideration while making an assessment of the risk management systems of banks under Annual Financial Inspections and Supervisory Review and Evaluation Process under Pillar II.

2.4 IRC represents an estimate of the default and migration risks of unsecuritised credit products over a one-year capital horizon at a 99.9 percent confidence level, taking into account the liquidity horizons of individual positions or sets of positions. Banks are expected to develop their own models for calculating the IRC of these positions. This appendix provides broad guidelines on how the IRC model should be developed. The guidelines contained in this appendix are basically high level

principles, with considerable flexibility afforded to banks in terms of how to operationalise these principles.

Principles for Calculating IRC

2.5 With the RBI approval, a bank can choose consistently to include all listed equity positions and derivative positions based on the listed equity of a desk in its incremental risk model, when such inclusion is consistent with how the bank internally measures and manages this risk at the trading desk level. If equity securities are included in the computation of incremental risk, default is deemed to occur if the related debt defaults.

2.6 However, when computing the IRC, a bank is not permitted to incorporate into its IRC model any securitisation positions, even when such securitisation positions are viewed as hedging the underlying credit instruments held in the trading account.

2.7 For IRC-covered positions, the IRC captures:

- **Default Risk** that is the potential for direct loss due to an obligor's default as well as the potential for indirect losses that may arise from a default event.

- **Credit Migration Risk** that is the potential for direct loss due to internal/external rating downgrades or upgrades as well as the potential for indirect losses that may arise from a credit migration event.

Key Parameters for computing IRC

2.8 In order to achieve broad consistency between capital charges for similar positions (adjusted for liquidity) held in banking and trading books as also due to the reason that the Basel II framework reflects a 99.9 per cent soundness standard over a one-year capital horizon, the IRC is also described in these terms. Banks may follow the provisions of IRB approach as given in the Basel II document. (International Convergence of Capital Measurement and Capital Standards, June 2006 and Enhancement to Basel II Framework, July 2009).

2.9 Specifically, for all IRC-covered positions, a bank's IRC model must measure losses due to default and migration at the 99.9 per cent confidence interval over a capital horizon of one year, taking into account the liquidity horizons applicable to individual trading positions or sets of positions. Losses caused by broader market-wide events affecting multiple issues/issuers are encompassed in this definition.

2.10 For each IRC position the model should also capture the impact of rebalancing positions at their liquidity horizons so as to achieve a constant level of risk over a one-year capital horizon. The model may incorporate correlation effects among the modelled risk factors, subject to validation standards set forth below. The trading portfolio's IRC equals the IRC model's estimate of losses at the 99.9 per cent confidence level.

Constant Level of Risk over One-Year Capital Horizon

2.11 An IRC model should 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 IRB approach of Basel II framework. In all cases (loans, derivatives and repos), the Basel II framework defines EAD in a way that reflects a roll-over of existing exposures when they mature.

2.12 The constant level of risk assumption and one year of capital horizon for computing IRC is taken on account of the need to ensure the appropriate capital needed to support the risk in the trading portfolio. It also reflects the importance to the financial markets of banks having the capital capacity to continue providing liquidity to the financial markets in spite of trading losses. Consistent with a "going concern" view of a bank, these assumptions are appropriate because a bank must continue to take risks to support its income producing activities.

2.13 This constant level of risk assumption implies that a bank rebalances, or rolls over, its trading positions over the one year capital horizon in a manner that maintains the initial risk level, as indicated by a metric such as VaR or the profile of exposure by credit rating and concentration. This means incorporating the effect of replacing positions whose credit characteristics have improved or deteriorated over the liquidity horizon with positions that have risk characteristics equivalent to those that the original position had at the start of the liquidity horizon. The frequency of the

assumed rebalancing must be governed by the liquidity horizon for a given position.

2.14 Rebalancing positions does not imply that the same positions will be maintained throughout the capital horizon, particularly for more liquid and more highly rated positions. However, a bank may choose to use a one-year constant position assumption, as long as it does so consistently across all interest rate positions in the trading portfolios.

Liquidity horizon

2.15 Banks have to pay particular attention to the appropriate liquidity horizon assumption within their IRC models. The liquidity horizon represents the time required to sell the position or to hedge all material risks covered by the IRC model in a stressed market. The liquidity horizon must be measured under conservative assumptions and should be sufficiently long that the act of selling or hedging, in itself, does not materially affect market prices. The determination of the appropriate liquidity horizon for a position or set of positions may take into account a bank's internal policies relating to, for example, prudent valuation adjustment and management of stale positions as per the prudent valuation guidance of RBI contained in Master Circular on New Capital Adequacy Framework.

2.16 The liquidity horizon for a position or a set of positions has a floor of three months.

2.17 In general, within a given product type, a non-investment grade position is expected to have a longer assumed liquidity horizon than an investment grade position. Conservative assumptions regarding the liquidity horizon for non-investment grade positions are required until further evidence is gained regarding the market's liquidity during systematic and idiosyncratic stress situations. The banks also need to apply conservative liquidity horizon assumptions for products, regardless of rating, where secondary market liquidity is not deep, particularly during periods of financial market volatility and investor risk aversion. The application of prudent liquidity assumptions is particularly important for the growing product classes that have not been tested in a downturn.

2.18 A bank can assess liquidity by position or on an aggregated basis ("buckets"). If an aggregated basis is used, the aggregation criteria would be defined in a way that meaningfully reflects difference in liquidity of different positions.

2.19 The liquidity horizon is expected to be higher for positions that are concentrated, reflecting the longer period needed to liquidate such positions. This longer liquidity horizon for concentrated positions is necessary in order to provide adequate capital against two types of concentration: issuer concentration and market concentration.

Correlations and diversification

2.20 Economic and financial dependence among obligors causes a clustering of default and migration events. Accordingly, the IRC charge includes the impact of correlations between default and migration events among obligors and a bank's IRC model must include the impact of such clustering of default and migration events.

2.21 The impact of diversification between default or migration risks in the trading book and other risks in the trading book is not currently well understood. Therefore, for the time being, the impact of diversification between default or migration events and other market variables would not be reflected in the computation of capital for incremental risk. This is consistent with the Basel II Framework, which does not allow for the benefit of diversification when combining capital requirements for credit risk and market risk. Accordingly, the capital charge for incremental default and migration losses is added to the VaR-based capital charge for market risk.

Concentration

2.22 A bank's IRC model must appropriately reflect the issuer and market concentrations. Thus, other things being equal, a concentrated portfolio should attract a higher capital charge than a more granular portfolio (see also paragraph 2.19). Concentrations that can arise within and across product classes under stressed conditions must also be reflected.

Risk Mitigation and Diversification Effects

2.23 Within the IRC model, exposure amounts may be netted only when long and

short positions refer to the same financial instrument. Otherwise, exposure amounts must be captured on a gross (i.e., non-netted) basis. Thus, hedging or diversification effects associated with long and short positions involving different instruments or different securities of same issuer (“intra-obligor hedges”), as well as long and short positions in different issuers (“inter-obligor hedges”), may not be recognised through netting of exposure amounts. Rather, such effects may only be recognised by capturing and modelling separately the gross long and short positions in the different instruments or securities.

2.24 The IRC model should also reflect the significant basis risks by product, seniority in the capital structure, internal or external rating, maturity, vintage for offsetting positions as well as differences between offsetting instruments, such as different payout triggers and procedures.

2.25 If an instrument has a shorter maturity than the liquidity horizon or a maturity longer than the liquidity horizon is not contractually assured, the IRC must, where material, include the impact of potential risks that could occur during the interval between the maturity of the instrument and liquidity horizon.

2.26 For trading book risk positions that are typically hedged via dynamic hedging strategies, a rebalancing of the hedge within the liquidity horizon of the hedged position may also be recognised. Such recognition is only admissible if the bank (i) chooses to model rebalancing of the hedge consistently over the relevant set of trading book risk positions, (ii) demonstrates that the inclusion of rebalancing results in a better risk measurement, and (iii) demonstrates that the markets for instruments serving as hedge are liquid enough to allow for this kind of rebalancing even during periods of stress. Any residual risk resulting from dynamic hedging strategies must be reflected in the capital charge. A bank should validate its approach to capture such residual risks to the satisfaction of the RBI.

Optionality

2.27 The IRC model must reflect the impact of optionality. Accordingly, bank’s models should include the non-linear impact of options and other positions with material non-linear behaviour with respect to price changes. The bank should also

have due regard to the amount of model risk inherent in the valuation and estimation of price risks associated with such products.

Use of internal risk measurement models to compute the IRC

2.28 As mentioned earlier, these guidelines do not prescribe any specific modelling approach for capturing incremental risk. Since, there is no single consensus method for measuring risk of potentially illiquid trading positions, it is anticipated that banks will develop different IRC modelling approaches.

2.29 The approach that a bank uses to measure the IRC is subject to the "use test". Specifically, the approach must be consistent with the bank's internal risk management methodologies for identifying, measuring, and managing trading risks.

2.30 Ideally, the principles set forth in this appendix would be incorporated within a bank's internal models for measuring trading book risks and assigning an internal capital charge to these risks. However, in practice, a bank's internal approach for measuring trading book risks may not map directly into the supervisory principles in terms of capital horizon, constant level of risk, rollover assumptions or other factors. In that case, the bank must demonstrate that the incremental capital charge resulting from its internal model would deliver a charge at least as high as the charge produced by a model that directly applies the foregoing principles.

Additional Validation requirements of the Incremental Risk Charge (IRC) Model

2.31 Liquidity horizons should reflect actual practice and experience during periods of both systematic and idiosyncratic stresses.

2.32 The IRC model for measuring default and migration risks over the liquidity horizon should take into account objective data over the relevant horizon and include comparison of risk estimates for a rebalanced portfolio with that of a portfolio with fixed positions.

2.33 Correlation assumptions must be supported by analysis of objective data in a conceptually sound framework. If a bank uses a multi-period model to compute incremental risk, it should evaluate the implied annual correlations to ensure they are reasonable and in line with observed annual correlations. A bank must validate that its modelling approach for correlations is appropriate for its portfolio, including the

choice and weights of its systematic risk factors. A bank must document its modelling approach so that its correlation and other modelling assumptions are transparent to RBI.

2.34 Owing to the high confidence standard and long capital horizon of IRC, robust direct validation of the IRC model through standard back-testing methods at the 99.9%/one-year soundness standard will not be possible. Accordingly, validation of an IRC model necessarily must rely more heavily on indirect methods including, but not limited to, stress tests, sensitivity analyses and scenario analyses, to assess its qualitative and quantitative reasonableness, particularly with regard to model's treatment of concentrations. Given the nature of IRC soundness standard, such tests must not be limited to the range of events experienced historically.

2.35 Banks should strive to develop relevant internal modelling benchmarks to assess the overall accuracy of their IRC models.

3. SPECIFIC RISK MODELLING UNDER THE IMA: PILLAR II

Banks wishing to model the specific risk arising from their trading activities, should conservatively assess the risk arising from less liquid positions and/or positions with limited price transparency under realistic market scenarios. Where the RBI considers that limited liquidity or price transparency undermines the effectiveness of a bank's model to capture the specific risk, it will take appropriate measures, including requiring the exclusion of positions from the bank's specific risk model. RBI would review the adequacy of the bank's measure of the specific risk including IRC; where the bank's approach is inadequate, the use of the standardised specific risk charges may be required.

APPENDIX 4
(cf. paras 2.1 & 12.4)

DOCUMENTS TO BE SUBMITTED BY THE BANKS TO THE RBI FOR SEEKING APPROVAL OF INTERNAL MODELS OF MARKET RISK

1. For obtaining the RBI approval for the internal market risk models of banks, following documents are required to be submitted by the banks:

a) Request for RBI approval of IMA model
b) Internal audit report of the model
c) A Market Risk (MR) File
d) M R Model Dossier (cf para 7.3 of Annex)

The contents of the MR file are described as under:

1.1 MR FILE

The MR file will describe the internal model, the risk-management control system and should substantiate the compliance with the quantitative and qualitative requirements of these guidelines. The information required in the MR File is structured in the following sections:

1.1.1 Scope of Application of the Model

The scope of application of the model for which approval is requested shall be precisely determined, in terms of the risks assumed. The scope of the internal model shall coincide with the trading activity and operations performed by the institution in relation to the products subject to market risks. If the potential activity involving market risk does not coincide with the scope of the application, an explanation shall be given as to why a part is excluded from the model. The transactions not included shall, in any event, be exceptional and of marginal importance in relation to the institution's total trading activity.

1.1.2 Description of the Exposures

Details of the current exposures by product and risk factor (valuation of positions and estimated value at risk) and the distribution of risk by business unit with the most detailed breakdown possible should be furnished.

1.1.3 Estimation of Regulatory Capital

Information on the estimated regulatory capital for market risk, calculated both by applying the internal model and by the standardised method should be included.

1.1.4 Policies and Organisation

Details of the position in the bank's structure of the committees and units involved in the market risk management function including a definition of their responsibilities and functions. This should cover description of all units mentioned in para 7.5 of Annex. The information given will enable an assessment to be made as to whether there is an efficient separation of responsibilities and sufficient functional independence of the market-risk control and measurement units.

With respect to these units, it will be necessary to describe their functions, the numbers and qualifications of the staff, the details of their reporting lines and their relations with other areas of control and with business units. A list shall be included of the internal manuals of policies, procedures, methodologies, supplementary analyses (backtesting and stress testing) and information systems that shape market-risk management, measurement, control and information.

This section of the File shall also include a list of authorised products and any restrictions on their related transactions (terms, volumes, trading and hedging strategies, etc.) as well as the procedures established for the approval of new products.

1.1.5 Measurement Systems

A detailed description of the methodology used for VaR estimates will be given including the following aspects:

a) Model input values, with details of the historical period of observation of the risk factors used and of the time horizon for the maintenance of positions, indicating the methodological treatment employed if such time horizon differs from the regulatory one.

b) Market variables captured, with details of the sources and methodology of the secondary calculations derived from such market input values: estimation of zero coupon curves, calculation of market factor volatilities and description of any smoothing criteria, estimation of risk-factor correlations, etc.

c) Input values and integrity of positions subject to market risk, with a description of the methodology employed in the introduction of input values for positions in the model (in particular, any cash flow association techniques and estimation of sensitivity to the different risk factors in financial options).

d) Methodology for product valuation and VaR estimation, with a description of the valuation models used, of the specific methodology applied in the estimates of value at risk and in the aggregation of risk across different business units, of the criteria for simulating risk factors, and of the coverage by model of the specific risk of fixed-income and equities. The different methodologies applied must be appropriate for the level and complexity of the operations, with any known limitations specifically identified.

1.1.6 Stress Analysis Programme

The description of the structure of stress analysis programmes shall include the definition and selection methodology for scenarios, the periodicity and criteria for their review, as well as the policies for limits on risk assumption in stress situations and the information periodically supplied to the directors and senior management. The stress scenarios considered (whether historic, anticipatory, or worst-case) shall be those that are most appropriate given the risk positions and structures maintained by the institution.

1.1.7 Back-testing Programme

Together with the results of the previous year's back-testing, the back-testing exceptions should be explained and also the definition of daily profits and losses (preferably both hypothetical and actual) and any adjustment criteria. Irrespective of other considerations regarding the tests carried out on actual profits or losses, which incorporate intraday operations and other commissions charged or paid, how good the model is shall be assessed on the basis of hypothetical or "clean" back-testing, carried out daily by comparing the estimated value at risk on end-of-day positions with the hypothetical change in the value of the same portfolio at the end of the following day.

For the purposes of determining regulatory capital, the back-tests, and any increase in the scaling multiplication factor arising from the number of exceptions observed over the last 250 days, shall be carried out on the whole portfolio. However, additional tests should be performed at disaggregated levels, broken down by

portfolio, dealing unit and type of risk in order to test the model's predictive power more efficiently.

1.1.8 Technological Environment and Information Integrity Controls

The description of the technological environment shall include a diagram explaining the systems involved in the process of measurement and control of market risk (basically, systems to capture market variables, systems to capture positions, valuation systems and VaR calculation systems) and information flows between systems. Of the controls established to ensure the integrity of the information, at least the following procedures shall be detailed:

a) Processes to reconcile positions between the trading-room, accounting and risk systems.

b) Procedures to identify the boundaries of the portfolios included in the model.

c) Procedures for the daily analysis of risk exposures.

d) Procedures for validating the sources of market prices, their volatilities and correlations.

1.1.9. Structure of Limits

The information supplied on limits put on market risk shall cover their definition, the hierarchical structure and the procedures established for their approval, modification, control and monitoring, and notification of excesses over such limits. The use tests available to ensure the efficacy of the approved limits, both in terms of their actual utilization and in relation to the business budget of the units involved, shall be attached.

1.1.10 Information Systems

The description of the information systems established shall include the details of the different regular or ad hoc reports, to notify the risks assumed, the management results and any excesses or deviations, as well as their recipients. Institutions shall attach all relevant information that ensures the effectiveness of the communication systems established for taking decisions (the minutes of business and risk committees, the management of possible excesses over risk limits, loss limits, decisions to close or hedge positions assumed, etc.).

1.1.11 Databases of the Relevant Information for Market Risk Management

a) Daily VaR series, correlated at the overall and disaggregated levels, with the highest degree of detail available.

b) Series of profits and losses used in back-tests, with the highest level of disaggregation available.

c) Daily series of the various risk factors (interest rates, exchange rates, equity prices, implied volatilities in options, etc.) used in VaR estimates.

1.1.12 Details of Tables of Applications to Calculate Market Risk

Institutions shall include the functional application manuals of the VaR calculation and the tables of model input values (positions and market factors), with details of the fields and their description, and the details of the tables of the partial calculations necessary to estimate the overall market risk of the scope of the model. The ability to make available to the RBI the data necessary to verify the integrity of the information and to permit VaR estimates at a particular date to be replicated shall be substantiated.

1.1.13 Future Developments and Implementation Schedule

In particular, the incorporation of any units or portfolios subject to market risk, that were initially excluded from the scope of the model, and any planned changes or future plans that have a bearing on the systems used to measure and control the risks to which the authorisation application refers shall be explained.

1.1.14 Other Independent Assessments

Copy of the internal audit reports should be submitted , reports of any external audits that may have been carried out along with the tests performed to review the risk control systems and, in particular, the procedures implemented to measure and verify precisely and rigorously the position input values.
