Date: 14-01-2016 **Nr. 6656**

BEST PRACTICE GUIDELINE

From the Banking Regulation and Supervision Agency:

GUIDELINE ON STRESS TESTINGS TO BE USED BY BANKS IN CAPITAL AND LIQUIDITY PLANNING

Introduction

Stress testing plays a particularly important role in:

- providing forward-looking assessment of risks;
- overcoming limitations of models and historical data;
- supporting internal and external communication;
- feeding into capital and liquidity planning procedures;
- informing the setting of a banks' risk tolerance; and
- facilitating the development of risk mitigation or contingency plans across a range of stressed conditions.
- being an element of internal model approach relating to amounts subject to credit, market and operational risk within the scope of Pillar I.

Stress testing is especially important after long periods of benign economic and financial conditions, when fading memory of negative conditions can lead to complacency and the underpricing of risk. It is also a key risk management tool during periods of expansion, when innovation leads to new products that grow rapidly and for which limited or no loss data is available.

Board of directors and senior management must use of stress testing in banks' risk governance and capital planning. This includes setting stress testing objectives, defining scenarios, discussing the results of stress tests, assessing potential actions and decision making. At banks that were highly exposed to the financial crisis and fared comparatively well, senior management as a whole took an active interest in the development and operation of stress testing, with the results of stress tests serving as an input into strategic decision making which benefited the bank. Stress testing practices at most banks, however, did not foster internal debate nor challenge prior assumptions such as the cost, risk and speed with which new capital could be raised or that positions could be hedged or sold.

The financial crisis has also revealed weaknesses in organizational aspects of stress testing programs. Prior to the crisis, stress testing at some banks was performed mainly as an isolated exercise by the risk function with little interaction with business areas. This meant that, amongst other things, business areas often believed that the analysis was not credible. Moreover, at some banks, the stress testing program was a mechanical exercise. While there is room for routinely operated stress tests within a comprehensive stress testing program (eg for background monitoring), they do not provide a complete picture because mechanical approaches can neither fully take account of changing business conditions nor incorporate qualitative judgments from across the different areas of a bank. Furthermore, in many banks, stress tests were carried out by separate units focusing on particular business lines or risk types. This led to organizational barriers when aiming to integrate quantitative and qualitative stress testing results across a bank.

Stress tests cover a range of methodologies. Complexity can vary, ranging from simple sensitivity tests to complex stress tests, which aim to assess the impact of a severe macroeconomic stress event on measures like earnings and economic capital. Stress tests may be performed at varying degrees of aggregation, from the level of an individual instrument up to the institutional level. Stress tests are performed for different risk types including market, credit, operational and liquidity risk.

Notwithstanding this wide range of methodologies, the turmoil has highlighted several methodological weaknesses. First, weaknesses in infrastructure limited the ability of banks to identify, measure and aggregate exposures across the bank. This weakness limits the effectiveness of risk management tools – including stress testing. Second, most risk management models, including stress tests, use historical statistical relationships to assess risk. They assume that risk is driven by a known and constant statistical process, ie they assume that historical relationships constitute a good basis for forecasting the development of future risks. The turmoil has revealed serious flaws with relying solely on such an approach. Given a long period of stability, backward-looking historical information indicated benign conditions so that these models did not pick up the possibility of severe shocks nor the build up of vulnerabilities within the system. Historical statistical relationships, such as correlations, proved to be unreliable once actual events started to unfold. Third, the financial crisis has again shown that, especially in stressed conditions, risk characteristics can change rapidly as reactions by market participants within the system can induce feedback effects and lead to system-wide interactions. Scenarios which were designed prior to the crisis less considered the correlation changes in positions, risk types and markets caused by the mentioned interaction and feedback effects and they were designed to reflect shorter periods and smooth regressions.

In order to remove the above-mentioned weaknesses, it was necessary to design more sophisticated approaches which apply shocks to many parameters simultaneously and which are either historically based or hypothetical.

Particular risks that were not covered in sufficient detail in most stress tests include:

- the behavior of complex structured products under stressed liquidity conditions;
- Pipeline or Securitization risk and implicit support,
- basis risk in relation to hedging strategies;
- counterparty credit risk;
- contingent risks; and
- funding liquidity risk.

Banks recognize that current stress testing frameworks must be enhanced both in terms of granularity of risk representation and the range of risks considered. More general areas in which banks are considering future improvement include:

- constantly reviewing scenarios and looking for new ones;
- examining new products to identify potential risks;
- improving the identification and aggregation of correlated risks across books as well as the interactions between market, credit and liquidity risk; and
- evaluating appropriate time horizons and feedback effects.

On the other hand, banks should not restrict themselves to a check list approach for improving their stress testing programs, instead, they should question their work and transactions and reinforce efforts made by them to improve their practices.

In accordance with this guideline, an effective and sufficient stress testing program is implemented by considering the complexity and size of bank's activities on both consolidated and non-consolidated basis as well as the followings:

- Responsibility of the senior management,
- Intra-bank policies as well as principles and procedures relating to risk management,

- Adequate stress testing measurement, monitoring and control processes,
- Comprehensive internal control and internal audit processes.

Within the scope of the above-given introduction, the principles on stress testing to be implemented and applied by Turkish banking sector within the scope of Section 4 "Risk Management System" and Section 5 "ICAAP" of the Regulation on Internal Systems of Banks" are explained. Accordingly, management aspect, technical aspect as well as principles and explanations relating to firm-wide stress testing implementation are given, moreover definitions and abbreviations as well as sample template on stress testing report are given in the annexes.

I. OBJECTIVE AND SCOPE

1. The purpose of this guideline is to explain the best practices expected from banks within the frame of Article 43 "Stress Testing Program" of the Regulation on Internal Systems of Banks and Internal Capital Adequacy Assessment Process (Regulation on Internal Systems and ICAAP) published in the Official gazette dated 11.07.2014 and NR. 29057.

2. The guideline is based on Article 93 of the Banking Law Nr. 5411 dated 19.10.2005 and Article 7/A "Best Practice Guidelines" of the Regulation on Principles and procedures on the Audit to be made by the Banking Regulation and Supervision Agency published in the Official gazette dated 22.07.2006 and Nr. 26236.

II. GOVERNANCE ASPECTS OF STRESS TESTING AND USE

3. General risk management principles stipulated in Section 4 titled "Risk Management System" and Section 5 titled "ICAAP" of the Regulation are also valid for stress testing program. In this guideline, how the mentioned principles will be implemented in stress testing is explained.

4. Banks are obliged to adapt to all the provisions stipulated in Article 43 titled "Stress Testing Program" of the Regulation. This guideline is arranged to determine the principles on the implementation of the mentioned article and banks are expected to be in compliance to the extent with their structures, size and complexity of the Bank’s activities. Principles stated in this guideline make a base for supervision and surveillance activities of the Agency.

5. Within the scope of this guideline, stress testing defines all the implementations enabling the forward-looking evaluation of possible events or changes that could adversely impact the bank.

6. Accordingly, implementation of an effective stress testing enables the bank to define and measure its significant risks and vulnerabilities which may arise from both negative developments peculiar to the bank and the developments in stressed economic and financial environment. This program shall support other quantitative risk management methods and qualitative implementations including the predictions of statistical risks and losses especially based on historical data. Therefore, stress testing must help to reveal undefined or underestimated risk concentrations, mutual interactions and their possible effects to the bank's financial structure under stressed periods.

7. Stress testing program shall include clearly defined purposes, good designed scenarios in compliance with the bank's activities and its risk arising from those activities, written assumptions, a strong methodology providing the evaluation of possible affects on bank's financial structure, reporting based on the decisions taken, revising stress testing processes in a continuous and efficient manner and management actions based on stress testing results.

8. Stress testing program shall provide the bank with consistent and repeatable implementations focusing on evaluation of its significant risks, activities and strategies as well as implementing ad hoc

scenarios when necessary. Program must be in a structure which handles stressed events and situations both peculiar to the bank and on systemic base as well as considers the hypothetic events and cases which bear a negative impact on the bank's operations and financial structure.

9. Stress testing program shall include, but not be limited with; risk defining and measurement, predicting income and expenditures on workflow basis and feeding workflow strategies, defining vulnerabilities, evaluating probable losses to occur from the mentioned vulnerabilities and determining the appropriate actions, evaluating the capital adequacy and planning the capital, evaluating the liquidity adequacy and contributing to funding plans, providing the integration between the management's decisions on strategies, risk management, capital and liquidity planning as well as helping to the decision-making plans.

10. Beside periodical stress testing, a bank shall have the flexibility to implement new or ad hoc stress testings towards sudden risks. In a broad sense, a bank shall update its stress testing program and control its validity within the scope of newly arising risks to contribute to better understanding of bank's risks and activities, new stress testing techniques and activity environment.

Above-mentioned government aspects are detailed within the frame of below-mentioned principles.

Principle 1. The board of directors has ultimate responsibility for implementing and effective operation of the overall stress testing program. The board of directors should be able to understand the impact of stress events on the overall risk profile of the bank.

11. The **board of directors** has ultimate responsibility for the implementation and execution of the overall stress testing program. This is essential in order to ensure the authority of the stress testing program at all levels of the bank and to ensure that the **board of directors** fully understands the impact of stress events on the overall risk profile of the bank. Their engagement will also help to maximize effective use of the program, especially with respect to firm-wide stress testing and capital planning, in terms of the outputs of the stress tests and the limitations of the stress tests (e.g. probability of the event occurring or judgmental bias in a stress test’s specification).

12. Practical aspects of stress testing, such as identification of risk drivers, implementation, management, etc., may be delegated to senior management. However, the **board of directors** (or relevant designated committee) should actively engage in the discussion, and where necessary challenge, the key modeling assumptions and scenario selection and is expected to question underlying assumptions in order to identify weaknesses of the stress testing. The board of directors should question the assumptions (e.g.whether assumptions about correlations in a stressed environment are reasonable) and the credibility of management intervention and mitigating actions based on stress test results (as one of a range of risk management tools) and as a result of this process it should make a compromise.

13. It may have additional contribution to establish risk management committee(s) by the board of directors where thorough discussions with risk managers about the design, assumptions, results, limitations and implications of the stress testing program are conducted.

Principle 2. The stress testing program should be an integral part of a bank’s risk management framework and be supported by an effective infrastructure.

14. Stress testing should be integrated into a bank’s risk management processes. For example, the stress test program should:

- analyze the aggregate of a bank’s businesses and risk types as well as the separate components of portfolios, risk types and business lines;

- factor in the relationships between risk types;

- support bottom-up and top-down stress testing, including reverse stress-testing;

- have a flexible platform that enables modeling of a wide variety of stress tests across business lines and risk types as and when the senior management require;

- draw data from across the organization, as needed; and

- enable intervention to adjust assumptions in a straight forward manner.

15. One of the factors which makes stress testing program is embedded in risk management is that stress testing is an integral part of the Internal Capital Adequacy Assessment Process (ICAAP). The ICAAP should be forward-looking and take into account the impact of a severe scenario that could impact the bank. The ICAAP should demonstrate that stress testing reports provide the board of directors with a thorough understanding of the material risks to which the bank may be exposed.

16. In order for stress testing to be a meaningful part of the risk management framework, stress tests should be undertaken with appropriate frequency. In some risk areas, stress testing is necessarily done frequently while overarching firm-wide stress testing may be done with lower frequency. For large scaled and complex banks they will have a number of risk areas requiring frequent stress testing e.g. market risk, which will inform the broader stress testing framework. Small scaled and simpler banks may not have the same range of requirements. The frequency of stress testing should be proportionate to risk areas and the need for overall firm-wide stress testing. The stress testing program should also allow for ad hoc stress tests.

17. Overall firm-wide stress testing to be used in a bank's capital and liquidity planning shall be made in the frequency needed as to the changes in risk profile and economic movement not to be less than at least once a year and always by year-ends.

18. The stress testing program should be supported by an appropriate infrastructure and/or data framework allowing for both flexibility and appropriate levels of quality and control. Infrastructure and/or data frameworks should be proportionate to the size, complexity, risk and business profile of a bank, and allow for the performance of stress tests covering all material risks a bank is exposed to. A bank should ensure that it devotes sufficient resources to developing and maintaining such infrastructures and/or data frameworks including appropriate resources and IT systems, where applicable, that facilitate effective data delivery and processing in a quantitative and qualitative manner.

19. The stress testing infrastructure and/or data framework of a cross-border group, should allow stress tests to be conducted at various levels of the organization, including at the consolidating level, but also at the level of material entities. Alternatively, in cases where the bank applies a centralized approach to risk management, and stress tests are being conducted predominantly at the consolidated level, the design of the stress testing program should allow for articulation of the impact/results of the group (consolidated) level stress tests to material entities and/or business lines.

Principle 3. Stress testing programs should be appropriate to analyze and question and shall be used in decision making at all appropriate management levels of a bank.

20. The stress testing program, as part of a range of risk management tools, supports different business decisions and processes including strategic decisions. Such decisions should take into consideration the shortfalls of stress testing and the limitations of the assumptions used.

21. The board of directors has responsibility for evaluating relevant output from the stress testing program and for taking appropriate management actions. These measures or actions may vary

depending on the circumstances and other available information, examples of such actions, although not exhaustive are:

a. reviewing the set of limits, especially in cases where legislative requirements indicate that the results of the stress tests should be reflected in the limits (i.e. requirements relative to market risks and to credit risk mitigation techniques);

b. use of risk mitigation techniques;

c. reducing exposures or business in specific sectors, countries, regions or portfolios;

d. reconsidering the funding policy;

e. reviewing capital and liquidity adequacy;

f. reviewing strategy;

g. reviewing the risk appetite; and

h. review of or reimplementation of stress test scenarios and data structure according to a new development or a development of a framework where one does not exist.

22. The results of stress tests should also be used as input to the process of establishing a bank's risk appetite and fixing exposure limits as well as a planning tool to determine the effectiveness of new and existing business strategies and their impact on capital utilization. Stress tests are also a suitable tool to identify tail risk, for which explicit risk appetite levels may be set.

Principle 4. A bank should have clear responsibilities, allocated resources and written policies and procedures in place to facilitate the implementation of the stress testing program.

23. The bank shall govern and direct the implementation via powers and responsibilities clearly defined by written policies and procedures which are approved by board of directors and revised annually at minimum. Policies shall;

a. set the types of stress testing and the main purpose of each component of the program;

b. define clearly the stress testing practices in a consistent, certain and adequate manner throughout the bank,

c. determine workflow and processes relating to stress testing, roles and responsibilities- so as to include the controls over external resources (ex. data providers and sellers) used in any phase of the stress testing,

d. define frequency and priorities of stress testing activities which are probable to vary according to type and purpose

e. the methodological details of each component, including the definition of relevant scenarios and the role of expert judgment;

f. show how stress testing results will be used, what will be management actions depending on results and by whom the decisions will be made,

g. revise stress testing practices in order to ensure them give valid and appropriate results continuously, be updated when necessary; adopt to changes in market conditions, bank's product and strategies, bank's risk and activities, risk appetite and the stress testing practices of the sector.

24. The bank should ensure that it devotes sufficient resources and develops explicit procedures to undertake rigorous, forward-looking stress testing. The bank should document the assumptions and fundamental elements for each stress testing exercise. These include the reasoning and expert judgments underlying the chosen scenarios and the sensitivity of stress testing results to the range and severity of the scenarios, and to the range of business assumptions and planned remedial actions.

25. The bank shall be aware of the degree of statistical uncertainty arising from the instruments used in the model. In some cases, it will be more appropriate to use, instead of point predictions, potential error margin or statistical uncertainty criteria. In addition, qualitative evaluation and expert views shall exist almost in all stress testing including well-developed quantitative tests supported by qualified data. Role and impact over the result of the mentioned qualitative evaluation and expert views must be documented.

Principle 5. The bank should regularly review its stress testing program and assess its effectiveness and fitness for purpose.

26. A sound and robust stress testing program (e.g. design, scenarios, use of expert judgment and results) should be challenged by views and critics from various units across the bank. This requires strong dialogue between risk managers, economists, business managers and other relevant experts before it goes to senior management for challenge. Challenge between risk managers and business managers is likely to focus on the use and appropriateness of the stress testing program from a business perspective. The insights of specialists within macro-economic analysis are likely to be most valuable in the process of scenario selection and in the validation of stress test results. Involvement of different experts will help ensure that the challenge of the stress test program is both quantitative and qualitative.

27. The effectiveness and robustness of stress tests should be assessed regularly, qualitatively as well as quantitatively, in light of changing external conditions to ensure that they are up-to-date. An independent control function (eg. risk management unit or an independent function to be established in internal control unit) should play a key role in the process. The bank shall set the processes that control the soundness of outsourced resources (eg. systems and processes developed by third parties) relating to stress testing program, whether or not it is applied correctly by the bank, and whether or not it is in compliance with the bank's risks and activities.

28. Stress testing program shall comprise the validation for correctness and totality of stress testing process and results or an independent internal or out view with another feature. Working papers which are the basis of the mentioned validation or view shall be ready for the audit of the Agency. The following areas of assessment of the stress testing program should be considered:

a. the effectiveness of the program in meeting its intended purposes;

b. the need for development work;

c. systems implementation;

d. management oversight;

e. business and/or managerial assumptions used;

f. any other assumptions used;

g. data quality; and

h. documentation.

III. STRESS TESTING METHODOLOGIES (TECHNICAL ASPECT)

29. Principles handled under this title do not prescribe a certain methodology. They are designed to enhance banks' practices in stress testing, in particular by identifying the types of methodologies that should be considered by a bank in designing its stress testing program proportionate to its size and complexity. In a general sense, an effective stress testing program should consist of sensitivity analyses (single and simple multi-factor analyses) and scenario analyses addressing all material risks at various levels of the bank. Furthermore, stress testing program is expected to comprise firm-wide stress testing and reverse stress testing, as well. The combination of approaches as well as the level of detail will depend on the size and complexity of the specific bank. A smaller bank may place greater emphasis on the qualitative elements of its stress testing program supported by quantitative outputs of the balance sheet, whereas large sophisticated banks would be expected to run complex models which would be complemented by appropriate qualitative oversight.

30. Conceptual infrastructure of stress testing program shall be comprised of sound and more than one stress testing activities and approaches. All risk measurements, including stress testing, consist a statistical uncertainty factor (or error margin) depending on assumptions, limits of model and other features of previous term performance as well as following term predictions. Therefore, banks shall use more than one stress testing activities and approaches. At the same time, banks shall provide their approaches to be sound and reliable on conceptual basis. Stress testing shall be designed in different ways considering design and complexity depending on the level of stress applied and the number of factors considered. Integrity, benefit and clarity of stress testing shall not be damaged by the mentioned complexity level. In such cases, transition to relatively more simple testings shall be evaluated.

Sensitivity analysis

Principle 6. Banks should perform sensitivity analyses for specific portfolios or risks.

31. One of the main purposes of sensitivity analysis is to see the impact of assumptions on results. Its main difference from scenario analysis is its relation with the change (extreme or high level) occurred in variables, parameters and inputs not based on a reason or story in a negative case and within the frame of a certain input set. A bank shall be aware of that predicting such a relation is quite difficult in extreme conditions.

32. Sensitivity analysis is the simple stressing of one risk driver to assess the sensitivity of the bank to that risk driver. For example, bank might choose a simple interest rate shift stress or a straight forward shift in probabilities of defaults (PDs), or the default of their largest counterparties, or a decline in value of liquid assets. Such analyses provide information about key risks and enhance understanding about potential risk concentrations in one or several risk factors.

33. A bank should identify relevant risk drivers in particular: macro-economic risk drivers (e.g. interest rates), credit risk drivers (e.g. a change in bankruptcy law or a shift in PDs), financial risk drivers (e.g. increased volatility in financial instruments markets), and bank-peculiar or external events (e.g. operational risk events, market events, events affecting regional areas or industry sectors etc).

The bank should then stress the identified risk drivers using different degrees of severity. The severity of single factor shocks is likely to be influenced by long-term historical experience but banks are advised to supplement this with hypothetical assumptions to test the bank's vulnerability to specific risk factors.

34. A bank shall conduct sensitivity analyses at the level of individual exposures, portfolios or business units, as well as firm-wide.

35. Furthermore single factor analysis shall be supplemented by simple multi-factor sensitivity analyses, where a combined occurrence is assumed, without necessarily having a scenario in mind.

Scenario analysis

Principle 7. Banks should undertake scenario analysis as part of stress testing program. Scenario analysis should be (i) dynamic and forward- looking and (ii) incorporate the simultaneous occurrence of events within the frame of a consistent fiction.

36. Forward-looking hypothetical scenario analysis is a core part of the stress testing program that banks should include in their stress testing programs.

37. The development of a hypothetical scenario can start from historically observed realizations of risk parameters, but relying solely on historical scenarios has proved to be insufficient. Scenarios are based on risk factors and economic developments within the last 25 years. Pure historical scenarios can give insights into impact but not into the confluence of events that may occur. Moreover, as historical scenarios are purely backward-looking, they tend to neglect recent developments and current vulnerabilities. Therefore, scenario design should take into account systematic and bank-specific changes in the present and near future and thus be forward-looking. Accordingly, a range of scenarios should be considered encompassing different events and degrees of severity. The varying degrees of severity might be captured in the analysis of different events but would ideally encompass a program of several events with several degrees of severity. Moreover, scenarios should:

a. Address all the material risk types of a bank (e.g. credit risk, market risk, operational risk, interest rate risk and liquidity risk). The program, moreover, shall comprise non-contractual risks (eg. the reputation of the bank). In the case that certain portfolio, position, liabilities and business lines are not included, stress testing results may lead the bank to have a wrong confidence feeling.

b. Address the main risk factors (eg. all related interest rates, currency rates) the bank be exposed to. In this regard the results obtained from single factor analyses, which aim at providing information about the sensitivity towards single risk factors, may be used to identify scenarios that include a stress of a combined set of highly plausible risk factors. No material risk factor should be left unstressed or unconsidered.

c. Address major bank-specific vulnerabilities. These should take the regional and sectoral characteristics of a bank into account as well as considering specific product or business line exposures and funding policies.

d. Contain a narrative scenario which should include various trigger events, such as monetary policy, financial sector developments, commodity prices, political events and natural disasters. Narrative in this regard means that the co-movement of risk factors and the corresponding reaction of market participants are not implausible or paradoxical but yield a consistent picture of a possible overall future state.

e. Be internally consistent so that identified risk drivers behave in ways which are consistent with the other risk drivers in a stress.

f. Take into account developments in technology such as newly developed and sophisticated financial products and their interaction with the valuation of more traditional products.

g. Be forward-looking and include severe outcomes.

38. Banks should determine the time horizon of stress testing in accordance with the characteristics of the portfolio of the bank such as maturity and liquidity of the stressed positions, where applicable, as well as the risk profile and purposes of the particular exercise.

Banks shall use a minimum of 3years of time horizon in their reports relating to capital and liquidity planning. However, stress testing results could be produced for each quarter within the scope of time horizon.

39. Stress testing program shall be dynamic and flexible to reflect the changes in time in on-balance sheet and off-balance sheet transactions, portfolio composition, asset quality, activity environment, strategy, bank-peculiar risks or in macroeconomic structure and financial markets. Stress testing program shall go beyond historical data in hand and continuously question the settled assumptions. Banks shall ensure that stress testing not only be limited with past experiences but also include multi-scenarios so as to include the scenarios in recent past or the ones occurred in bank's history.

40. Stress testing shall be implemented by considering different time frequencies considering long-term negative conditions beside the ones to be expected in the near future. For instance, in case bank applies stress testing to credit and markets risks of a portfolio, a portion of credit risk losses may realize later than market risk losses or the speed and severity of losses arising from mark-to-market may bear a significant vulnerability. On the other hand, while significant results can occur when handled separately, the mentioned losses may be smaller when considered the change of loss according to time. Accordingly, bank shall evaluate the impact of stressed conditions on cumulative and incremental basis and consider especially the possible interactions between positions, activities, risks and possible indirect effects.

41. Stress scenarios shall reflect the factors which could singly affect the activities, risks or losses of a bank. For example, if a bank has concentrated its activities on a certain business line (like commercial or mortgage financing) stress testing shall have the nature to reveal the impact of any regression in the related markets.

Principle 8. Banks should identify appropriate and meaningful mechanisms for translating scenarios into relevant internal risk parameters that provide a firm-wide view of risks.

42. The formulation of a scenario includes explicit estimates/assumptions about the dependence structure between the main underlying economic and financial drivers such as interest rates, GDP, unemployment, equity, consumer and property prices, etc. The chosen scenario should be applied to all relevant positions (on- and off-balance sheet) of the bank. Banks should explain materiality criteria for all the positions for which the scenario was not applied.

43. It is key that the scenario composition, as well as the translation from macro-economic variables to internal risk parameters, is done consistently. Two main challenges emerge:

a. the formulation of a scenario that incorporates all facets of an economic environment in a sound manner; and

b. the transformation of these into internally consistent loss parameters (e.g. PD, LGD, write-offs, fair value haircuts etc.).

44. The links between underlying economic factors and internal losses or stressed risk parameters are likely to be based primarily on bank's experience and analysis, which may be supplemented by external

research and at times supervisory guidance. Benchmarks, such as those based on external research, may be quantitative or qualitative.

45. Due to the complexity involved in modeling hypothetical and macro-economic based scenarios:

a. banks should be aware of the model risk involved. A regular and conservative expert review of the model's assumptions and mechanics are important as well as a conservative modeling approach to account for model risk; and

b. a degree of conservatism may be appropriate when making assumptions that are hard to measure in a quantitative way (e.g. diversification) but that influence the model's outputs. Nevertheless, the bank is expected to be aware of the dependencies excluded and review their incorporation on a regular basis.

46. The transformation of external variables or events into internal losses or increased risk parameters is another challenging task. A bank should be aware of the possible dynamic interactions among risk drivers, the effects on earnings and on the off-balance sheet position.

47. A deep (probabilistic) understanding of how macro-economic variables and bank specific effects would impact the bank at any given point in time is important in stress testing modelling. Ideally, this transformation should be based on quantitative modelling where data is relatively rich and be based on expert judgment with supporting quantitative analysis where data is relatively scarce.

Principle 9. System-wide interactions and feedback effects should be incorporated within stress testing.

48. The stress test should explicitly identify interdependences, e.g. among regions and among sectors. The overall scenario should take into account system-wide dynamics – such as leverage building up across the system, closure of certain markets, risk concentrations in a whole asset class such as mortgages, and adverse feedback dynamics, for example through interactions among valuations, losses, margining requirements and insurance relations.

49. The strong links between the real economy and financial economy as well as the process of globalization have amplified the need to look at system-wide interactions and feedback effects. Such analysis can be very difficult to model quantitatively as it encompasses the reaction and behavior of other market participants under adverse conditions. Thus, banks may make qualitative assessments of the feedback effects of stress, for example, these effects would affect assumptions about management actions discussed below.

Severity of scenarios

Principle 10. Stress testing should be based on exceptional but plausible events. The stress testing program should cover a range of scenarios with different severities including scenarios which reflect a severe economic downturn.

50. Ensuring that a stressed scenario is appropriately severe is one of the elements required for ensuring that stress tests are:

a. meaningful in terms of providing the appropriate type of bank, as laid out elsewhere in these guidelines, which is designed to promote the stability of the bank and the financial system at all points in the economic cycle; and

b. consistently applied across the bank, recognizing that identical scenarios are not necessarily severe for all business lines.

51. Various degrees of severity should be considered for both sensitivity analysis and scenario stress testing but for capital planning at least a severe economic downturn is required.

52. Severity is to be determined in the light of the specific vulnerabilities of the respective bank. Therefore these vulnerabilities might not be equal to the perspective of the total economy. i.e., a simple country or region specific macro-economic stress scenario may be less relevant to some banks' risk profile than others; for example, if they have a specific industry exposure which is counter-cyclical or if their risks are primarily international and less impacted by national scenarios.

53. One of the main difficulties of scenario analysis is to convert a scenario, depending on the design of the test and scenario type used, to balance sheet effect, changes in risk indicators, potential losses amount and other criteria showing the negative financial impact. In scenario analysis, econometric and statistical analysis methods can be used (by extrapoling the current data base to see more rough conditions) to predict the relation between risk factors and risk drivers as well as post-stress risk predictions and loss projections. However, when predictions towards severe and ordinary negative conditions are made, no assumptions saying the relation between variables will be uniform would be made. Because, the linear relation between risk drivers and losses may not be linear under stressed conditions. In addition, banks shall be aware of that a few numbers of risk drivers can affect many different results.

The assumption of a linear response of the results to stressed parameters may not always hold and it is therefore crucial for a bank to achieve high awareness of non-linear interactions between macro parameters and stressed parameters. For example, it might be that only at a certain level of stress, certain hedging strategies might break down or come into effect; a subsidiary may also fail to be liquid only at a certain level of stress triggering further repercussion throughout the group.

54. Scenarios may include absolute or relative changes of parameters. An absolute scenario is one which, from a cycle neutral baseline, always has the same degree of severity. Thus, for example, in a downturn the stress would have a smaller impact compared to that experienced during a benign economic environment. A relative scenario, on the other hand, is a stress relative to the current situation and thus would be more severe in a downturn. It is unlikely that stress scenarios will be entirely absolute or relative. However, it is important that a bank is aware of the impact of absolute and / or relative changes on the severity of the chosen scenarios. Banks should be able to explain why they consider absolute or relative stress scenarios.

55. Banks should consider their capital requirements and resources over a plausible macro-economic base case, as well as a more severe stress scenario. Banks should be able to provide the forecasts that underpin their base case capital planning.

56. Banks may assess the appropriate level of severity of their capital planning stress against the scenario outlined in their reverse stress testing program. Identifying how the capital planning stress relates to the reverse stress test may help senior management justify why the severe stress scenario is appropriately severe.

57. In developing severe downturn scenarios, banks should also consider plausibility to the fullest extent possible. For example, as an economy enters recession banks should not necessarily always assume a further specific level of stress. There may be times when the stressed scenario is close to the base case scenario, but supplemented with specific shocks (e.g. interest rates, exchange rates).

58.In the case that a scenario range is also determined by the Agency for overall firm-wide stress testing within the scope of Article 59 titled "capital planning buffer" of the Regulation on Internal Systems and ICAAP, the same methodology is applied for all processes, excluding scenario forming phase, to whole bank and Agency scenarios.

Reverse stress testing

59. Reverse stress testing consists in identifying a significant negative outcome and then identifying the causes and consequences that could lead to such an outcome. In particular, a scenario or combination of scenarios that threaten the viability of the bank's business model is of particular use as a risk management tool in identifying possible combinations of events and risk concentrations within a bank that might not be generally considered in regular stress testing. A key objective of such stress testing is to overcome disaster myopia and the possibility that a false sense of security might arise from regular stress testing in which banks identify manageable impacts.

Principle 11. Banks should develop reverse stress tests as one of their risk management tools to complement the range of stress tests they undertake.

60. No single definition of reverse stress testing methodology is provided for the purposes of these guidelines. Reverse stress tests evolve around causes, consequences and impact, all of which are relevant and any of which can be taken as a starting point. Moreover, qualitative and quantitative approaches are appropriate, depending on the size and complexity of the bank. For example, a reverse stress test for simple and small banks could be a qualitative discussion of key risk factors and their possible combination in relation to the bank's risk profile at a senior management level. Alternatively, a more sophisticated quantitative approach could be used in identifying a specific loss level, or some other impact on the balance sheet (e.g. movements in capital ratios), and working backwards in a quantitative manner to identify the macro-economic risk drivers, and the required amplitude of movement, that would cause it.

61. Reverse stress testing is seen as one of the risk management tools usefully complementing the "usual" stress testing, which examines outcomes of predetermined scenarios. Reverse stress testing is a useful tool in risk management as it helps to understand potential fault lines in the business. Reverse stress testing is not expected to result in capital planning and capital add-ons. Instead, its use as a risk management tool is in identifying scenarios, and the underlying dynamism of risk drivers in those scenarios, that could cause a bank's business model to fail. This analysis will be useful in assessing assumptions made about the business model, business strategy and the capital plan. Reverse stress test results may also be used for monitoring and contingency planning.

62. Even for large and complex banks reverse stress testing may be undertaken in a more qualitative manner, focusing on the events and materialization of risk concentrations that could cause their business models to become unviable. As experience is developed, this might then be mapped into more sophisticated qualitative and quantitative approaches developed for other stress testing. Even in a qualitative sense, the impact of macro-economic shocks on a bank's solvency should consider first round and feedback effects as far as possible. Given the importance of a clear narrative running through the reverse stress test to identify business vulnerabilities and to develop an understanding of feedback and non linear effects, reverse stress testing is more than a simple sensitivity analysis e.g. simply shifting one relevant parameter to some extreme.

63. Reverse stress testing is made to determine the scenarios beyond the expectations on ordinary conditions in activity environment and to see the impacts of possible solid systemic changes on bank and it enables bank to question the assumptions concerning the business model's performance and risk mitigation techniques it will use under stressed conditions. It enables to predict realization probability of solid events and the threats. It is also good for revealing the compound impact of events and cases which are manageable on single basis but which are also extreme. For example, high level unemployment may have serious effects on credit losses. Furthermore, a volatility in market may lead to losses to the extent to increase funding costs. In addition, an abuse action in the bank may bring additional losses and disreputation. When all these effects occur simultaneously, they may have a nature to threat the existence of bank.

64. Among all scenarios threatening the existence of banks, a bank shall concentrate on the scenarios which would bear the biggest impact and besides, the scenarios which are probable to realize in the nearest period. Among significant vulnerabilities, focusing on the most important ones for the bank is good for priority designation for the scenario to be used in reverse stress testing. However, in order for bank to discover potential blind points, it shall consider a wide range of probable scenarios range.

IV. Portfolio, individual risk and firm-wide stress testing

65. Stress testing programs should encompass all the material risks (both on- and off-balance sheet) relevant for the banking group. To be effective, stress testing should consist of a multi-layered approach to capture risks at various levels in a bank. In this regard, according to the proportionality principle, the scope of stress testing could vary from simple portfolio level sensitivity analyses to comprehensive firm-wide scenario stress testing referring to the broadest perimeter.

Portfolio and individual risk level stress testing

Principle 12. Banks should perform stress tests on specific portfolios and the specific types of risk that affect them. Consideration should also be given to changes in correlations between risks that the bank identifies for a given portfolio.

66. It is important to perform stress tests on an individual portfolio basis using both sensitivity and scenario analysis. Banks should identify stresses that are severe with respect to a specific portfolio. For instance, in the case of a mortgage portfolio a decrease in house prices, high unemployment and a decline in GDP provide a severe scenario. Other portfolios, like for instance insurance, are exposed to different risk drivers and therefore a different stress scenario should be applied.

67. Banks should ensure they stress portfolios and business units to identify risk concentrations that may arise across their book. For example, a credit risk stress across asset classes and portfolios may identify potential concentrations between retail and corporate exposures.

68. An effective stress testing program shall be implemented in different aggregation levels (portfolios, business lines, risk types and bank-wide). In most cases, an aggregation level exceeding the business line or portfolio level may cushion the impact of a negative development on bank's financial status or cause it to be underestimated. In some cases, stress testing may be needed to be applied to a single risk amount or a single financial instrument. In this context, each stress testing shall be applied by aggregation on appropriate levels and have a form to include critical risk drivers required by related aggregation level, intra and out-of-bank factors which may affect the results and other related issues.

69. Banks should perform stress tests taking into account changes in correlations between risks recognizing interactions between risk types, such as market and credit risk, particularly in times of stress. For example, a bank invested in asset backed securities (ABS) and credit default swaps (CDS) could experience market and credit risk at the same time if ABS values fell and it was downgraded. The downgrade could trigger a clause in the CDS contracts obliging the bank to deliver collateral to counterparties. The call for collateral could decrease the possibility of obtaining secured funding forcing the bank to sell ABS, further decreasing the value of the portfolio.

Firm-wide stress testing

Principle 13. Stress testing should be conducted on a firm-wide basis covering a range of risks in order to deliver a complete and holistic picture of the bank's risks.

70. Risks at the firm-wide level may not be well reflected by simple aggregation of stress tests on individual risk areas or business units. Correlations, offsetting of individual exposures and concentrations may not be adequately captured and there may either be double counting of risks or underestimation of the impact of a stress scenario. Alternatively specific group risks may arise at a firm-wide level.

71. Therefore stress tests should be undertaken at a firm-wide level for all material risks. Once the material risks have been identified, banks should derive material risk drivers to inform the firm-wide stress. When looking at risks at a firm-wide level particular attention should be paid to risk concentrations on a holistic basis. Better insight can be obtained with respect to the correlations between and within risk categories. Notably, in times of stress correlations between risk categories tend to increase (for instance between market and funding liquidity risk).

72. Depending on the organizational structure and business model of a particular bank, a complete evaluation of all the risks affecting the bank would require the performance of stress test exercises at both consolidated and the level of material entities, which might be at the solo and/or a sub-consolidated level if appropriate. For instance, financial conglomerates are also expected to take into account the risks stemming from their insurance activities. Furthermore, a bank which is internationally active is also expected to perform stress tests at the level of business units in specific geographic regions or business sectors or business lines. Another aspect to be considered is that a severe stress scenario differs for different businesses and different geographic regions.

73. Firm-wide stress testing implementation requires a good scenario design and conversion of scenarios to loss indicators effectively. Mentioned implementation helps the evaluation of impacts arising from all risks under negative events and conditions but should be supported by other stress testing and risk measurement instruments. It must be considered that none of the methods can solely comprise all risks and negative conditions on its own.

74. Appropriate and comprehensive mechanisms shall be defined while showing the substantial impacts of scenarios on banks, first how the scenarios are converted into internal risk parameters and then how to reach to loss predictions by using those risk parameters as a whole. All business lines are not affected equally from a given scenario and a problem in one area may affect the others. However, since the main purpose is to see how the whole bank will be affected by a common scenario, assumptions foreseen for a certain scenario shall be fixed for all business lines and risk areas within the scope of a stress testing on bank scale.

V. Outputs of stress testing programs and management intervention actions

Principle 14. A bank should explain the outputs of its stress testing program by demonstrating the impacts on its regulatory capital and/or internal capital and resources, and also relevant balance sheet and P&L..

75. One essential output from a stress testing exercise is the estimate of the losses under a range of scenarios. The aim is to assess the capacity of a bank to absorb losses stemming from various shocks applied in the scenarios.

76. When undertaking stress testing, it is crucial to estimate potential losses which can derive from a specific configuration of macro-economic variables determined internally or exogenously. These potential losses mainly depend on:

- the risks already taken by a bank at a certain point in time - the starting point of the exercise;

-risks to be taken within the frame of strategic plan and budget,

- developments in the volume, asset quality and prices of investment and funding activities under the scenarios contemplated.

77. When stress testing over a specific time period, consideration should be given to appropriately conservative adjustments to profit and loss forecasts. Notably, loss assumptions in the stress do not have to coincide with accounting losses shown at that specific point in time.

78. With regard to credit risk, banks need to be aware of the impact of their ratings philosophies on the outcome. Misunderstandings can arise if they are not clearly specified when analyzing measures of losses in a stress test.

Principle 15. Banks should identify credible management actions addressing the outputs of stress tests and aimed at ensuring their ongoing solvency through the stressed scenario.

79. Banks are expected to consider a broad range of mitigating techniques and contingency plans against a range of plausible stressed conditions (not necessarily reverse stress tests) with a focus on at least a severe but plausible negative scenario.

80. To assess their possible responses to a stressed situation banks should consider the actions that are most relevant and when they would have to take them. Some actions may be required immediately. Others might be contingent on specific events happening, in which case clearly defined triggers for action should be identified beforehand. Others may be actions which the management would take, but these should be clearly agreed upon beforehand (for example, shareholders should be aware that dividends would be cut in some circumstances). Banks should not overestimate their ability to take mitigating management actions recognizing the possible impact of the stressed scenarios on other market participants (e.g. capital raising in stressed market conditions can be challenging).

81. When considering the impact of management actions, banks should explain the impact of the stress on both gross and net bases. Gross would obviously include assumptions about strategy, growth and associated revenue but exclude specific management actions in a stress such as winding down a business line or raising capital.

82. Management intervention and mitigating actions may involve, for example:

- the review of risk limits;

- the revision of policies, such as those that relate to funding or capital adequacy;

- changes in the overall strategy and business plan including a reduction of exposures to specific sectors, countries, regions, instruments or portfolios;

- recourse to risk mitigation techniques; and

- capital raising.

83. One of the measures available to management may be the raising of additional capital. The presence of a capital buffer, of appropriate quality, can be a significant mitigating factor as higher levels of capital increase the degree of freedom management has when taking mitigating actions.

84. A contingency plan should contain emergency actions in case standard measures turn out to be inadequate in the face of the most adverse scenarios. When defining their contingency plans banks should take into consideration the reduction of the efficiency as a consequence of extremely severe stressed situations.

VI. STRESS TESTING UNDER ICAAP

85. Capital and liquidity has a great importance on the existence of the bank. Therefore, reverse stress testing shall focus on both of them considering the interaction between capital and liquidity and the potential of their going worst together. Absence or shortage of capital or liquidity causes bank not to fulfill its financial intermediation duty and counterparties may have the impression that it cannot carry on its activities.

86. Stress testings relating to capital help the bank to better understand the vulnerabilities, better evaluation of negative effects on the capital position, maintenance of adequate capital amount for its business line by considering the complexity of activities and the risk profile. Furthermore, such stress testings are complementary for bank's legal capital analysis thanks to its forward-looking and structure and have the function of revealing the potential negative impact of unconsidered risks in regulatory capital and internal capital requirement calculation on capital level and ratios.

Principle 16. Banks should evaluate the reliability of their regulatory and internal capital requirements and liquidity planning based on stress test results.

87. Stress test results should be used to assess the viability of its regulatory and internal capital requirements and liquidity plan in adverse circumstances. To be effective for capital planning purposes, a range of scenarios should be considered including at least an adverse economic scenario that is severe but plausible, such as a severe economic downturn and/or a system-wide shock to liquidity. The stress should be firm-wide covering all relevant risk areas and material entities within the bank.

Principle 17. Stress tests should be consistent with a bank's risk appetite and strategy and contain credible mitigating management actions.

88. As a part of their stress testing programs, banks should develop firm-wide stress tests that are consistent with the risk appetite and overall (i.e. including business) strategy of the bank as set by the management body. Banks are expected to demonstrate a clear link between their risk appetite, their business strategy, their capital planning and stress testing programs. In particular, banks should assess and be able to demonstrate (by credible management actions, plans and other concrete steps, including changes in business strategy, reinforcing the capital base and/or other contingency plans) their ability to remain above regulatory and internal minimum capital requirements during a stress that is consistent with their stated risk appetite.

89. The assumptions used in the capital planning stress tests should be accurate with respect to banks' possible behavior in a time of stress and should be consistent with their stated risk appetite and business strategy. Resulting management actions based on changes to business strategy should have been identified, discussed and agreed at the most senior levels of the organization if they are to be considered credible.

90. Banks should document the results of their stress tests both gross and net of management actions. Mitigating management actions designed to reduce the impact of a stressed event should be clearly documented including explanations that justify the credibility and feasibility of those actions in a stressed environment. For example, actions such as asset sales, capital raising, capital injections from other parts of the group and rapid shifts in business strategies should all be treated with caution in times of stress.

VII. STRESS TESTING ON INDIVIDUAL RISK AREAS

VII.1. Market Risk

91. Market risk is the risk of losses in on- and off-balance-sheet positions arising from movements in market prices (e.g. stock prices, interest rates, foreign exchange rates and commodity prices).

92. Banks can consider a range of exceptional but plausible market shocks or scenarios for their trading book positions. For example, "exceptional" changes in market prices, shortages of liquidity in the markets and defaults/bankruptcy of large market participants can be taken into account. Dependencies between different markets and consequentially increasing correlations can also be factored in.

93. The stress tests applied and the calibration of those tests may reflect the nature of the portfolios, the trading strategies of the bank and the possibility, and time it could take, to hedge out or manage risks under severe market conditions.

94. Banks should design their risk management systems, including their internal models and stress tests, to properly measure the material risks in instruments they trade as well as the trading strategies they pursue. As their instruments and trading strategies change, internal models and stress tests should also evolve to accommodate the changes. Banks must demonstrate how they combine their risk measurement approaches to arrive at the overall internal capital for market risk.

Following paragraphs are valid for banks having internal model infrastructure for market risk calculation and reporting their internal model results to management.

95. Banks applying to use internal models to calculate capital requirements for market risks must frequently conduct a rigorous stress testing program and results of the mentioned program shall be revised by senior management and be reflected to policies and limits. In the bank's internal capital assessment it must demonstrate that it has enough capital to not only meet the minimum capital requirements but also to withstand a range of severe but plausible market shocks. Depending on the nature of the portfolio, stress testing shall include;

- Not be able to turn into cash /price gaps (so as to include interest rates and the exchange rate),

- Concentrated positions (depending on transaction volume in the market),

-One-way markets,

-Non-linear products/ extraordinarily high-loss positions,

-Events and sudden defaults,

-Correlations and significant shifts in volatility.

96. Furthermore, stress testing shall comprise other risks (for example uncertainty of salvage ratio, implied correlations or skew risk which are not handled sufficiently in minimum capital requirements calculated for market risks.

96A. The stress tests applied by a bank and, in particular, the calibration of those tests (e.g. the parameters of the shocks or types of events considered) should be reconciled back to a clear statement setting out the premise upon which the bank's internal capital assessment is based (e.g. ensuring there is adequate capital to manage the traded portfolios within stated limits through what may be a prolonged period of market stress and illiquidity, or that there is adequate capital to ensure that, over a given time horizon to a specified confidence level, all positions can be liquidated or the risk hedged in an orderly fashion). The market shocks applied in the tests must reflect the nature of portfolios and the time it could take to hedge out or manage risks under severe market conditions.

97. For those banks where regulatory capital is calculated under a more risk sensitive approach by being assessed against a 10 day time horizon and 99 percentile confidence level, it is still important that tail events beyond that confidence level are considered. A rigorous stress testing program could consider the following criteria:

- Assessing the consequences of major market disturbances and identifying plausible situations which could entail extraordinarily high losses. These plausible situations might also include events with low probability for all main risk types, especially the various components of market risks. The impact on stress cases on linear and non-linear products must be handled. Testings shall be applied on the appropriate aggregation level defined by the bank.

- Program must evaluate the results of main market fluctuations as well as realistic and plausible cases that may lead to extraordinary high losses. At portfolio level, the effects of changed correlations might be explored. Mitigating effects as consequences of contingency plans may have to be taken into account if the plans are based on plausible assumptions about market liquidity.

- Program shall comprise exceptional but plausible cases defined by the bank depending on the features of portfolio.

- A list of the measures taken to reduce risks and preserve own funds. In particular, limits on exchange rate, interest rate, equity price and commodity price risks set by banks may be taken into account against the results of the stress testing calculations.

VII.2. Securitization

98. With respect to securitization the stress testing program could cover complex and bespoke products such as structured credit products (securitization positions). Stress tests for securitised assets consider the underlying assets, their exposure to systemic market factors, relevant contractual arrangements and embedded triggers in the securitization structure, and the impact of leverage, particularly as it relates to the subordination level in the securitization structure.

99. Banks may underestimate the risk of some products by relying too much on external credit ratings or historically observed credit spreads related to (seemingly) similar products like corporate bonds with the same external rating. Such approaches cannot capture the relevant risk characteristics of complex, structured products under severely stressed conditions. Therefore, stress tests could include all relevant information related to the underlying asset pools - their dependence on market conditions - dependence of the securitization positions on market conditions, complicated contractual arrangements and effects related to the subordination level of the specific tranches.

100. Banks enhance their stress testing methodologies to capture the effect of reputational risk. They shall develop new methods for measuring reputational risk over other risk types in order to mitigate the spread effect and maintain the market confidence. In particular, to mitigate reputational spill-over effects and maintain market confidence, banks can develop methodologies to measure the effect of reputational risk on other risk types, with particular focus on credit, liquidity and market risks. For instance, a bank might include non-contractual off-balance sheet exposures in its stress tests to determine the effect on its credit, liquidity and market risk profiles.

101. Careful assessment of the risks associated with commitments to off-balance sheet vehicles related to structured credit securities and of the possibility that assets will need to be taken on balance sheet for reputational reasons. Therefore, stress testing programs could include scenarios assessing the size and soundness of such vehicles relative to their own financial, liquidity and regulatory capital positions. This analysis could include structural, solvency, liquidity and other risk issues, including the effects of covenants and triggers.

102. Warehouse/pipeline risk emerges when a bank is unable to perform the securitisation transaction or to access the securitisation market due to either bank specific or market stresses and could not transfer risks of the underlying assets since the investors are unwilling to take the risk although the bank is willing to securitise some of their assets. Stress testing is and important tool in the management of these risks. A bank should therefore include such exposures in their regular stress tests regardless of the probability of the pipeline exposures being securitised.

VII. 3. Credit risk

103. Stress tests may have to assess future credit losses and changes in capital requirements due to, for example, changes in credit quality and collateral values. For credit losses, the estimation of future losses in stress tests may in some cases rely on banks' credit risk parameters although these would not be applied in the calculation of capital requirements. Credit risk model approaches for losses and approaches which challenge historical relations and data are encouraged.

104 Credit risk comprises different risk types: default risk, spread risk and risk of decrease in rating grade. Stress testing program should be implemented by considering all risk types.

105. Banks may simulate credit quality migrations among categories of exposure and provide an estimate of the losses.

106. Credit risk calculations must include fiduciary credit transactions and investigate from which the final risk bear.

107. Credit quality effects include changes in risk weights of externally rated companies and changes in past due credits.

108. In computing the effect of stress tests on capital requirements, banks use methodologies coherent with the standardized framework. This requires developing a link between internal risk parameters and regulatory weights. If the bank uses external ratings it can infer, by the movements of the internal risk estimation, the rating migration. Credit stock volume may be treated in various ways in stress tests; as a risk driver in sensitivity analysis, part of a scenario or an indirect effect from a scenario. Whether the volume change is part of the scenario or an indirect effect from the scenario, careful consideration is given to market factors. Different banks may end up with different views about market factors such as credit supply, credit demand and competitors' behavior in a stress situation which may limit the use of the result.

Following paragraphs are valid for IRB (internal rating based) banks having internal rating based approach infrastructure and reporting their IRB results to management.

109. For IRB banks, the levels of applied risk parameters (such as PD, LGD and CF) form the basis for the stress tests. Stress tests also consider rating migrations, risk-weighted assets and credit losses. Capital requirements for the IRB approach could change depending on the stage within the economic cycle and stress tests should show the potential impact on capital requirements.

110. Banks may determine specific risk drivers for credit risk and how these risk drivers in turn affect a bank's total capital requirements for credit risk. Banks may find it helpful to develop these linkages on an asset class by asset class basis. For example, factors relevant to mortgages may be different to corporate finance.

111. Where a bank has numerous businesses, questions of diversification may arise, particularly across different geographic areas which may be subject to economic conditions that are not synchronized. Therefore it is not necessarily assumed that the aggregated impact is equal to the simple sum of each business's figures. However, in the spirit of the stress test, banks may apply reasonable conservatism in specifying dependencies and be able to justify their choices.

112. Stress test results may include changes in relevant credit parameters, in RWA and in EL levels. For the PD parameter, banks may apply different estimates for purposes other than capital requirement calculation, such as pricing or economic capital models. Under stressed conditions it is expected first point-in-time PD estimates will be affected. As a consequence there may be a need to make adjustments for cyclical (through-the-cycle) estimates of parameters.

113. There is no expectation that the stress tests will necessarily produce an LGD that is different than, the LGD estimated according to the IRB downturn requirement. To the extent that the identification of downturn periods coincides with the stress tests the calculation may turn out to be similar. For this reason, some stress test calculations may function as one tool for assessing the robustness of the LGD estimation.

114. Stressed LGD rates reflects economic downturn conditions. If observed LGD rates for a given obligor cohort are higher than those implied by the downturn LGD figures, then the stress tests may be updated to include the observed conditions. Moreover scenarios where LGD rates deteriorate even further might be considered to be included in stress testing program.

115. The level of capital needed to absorb potential credit migration/default losses is a function of the relationship between obligors in a given portfolio. As the correlation between portfolio obligors typically increases significantly during stressed periods, banks may test the impact of changes in the relationships between obligors using plausible yet adverse scenarios.

116. Banks applying IRB approach are required to implement stress testing. Mentioned banks, within the scope of IRB approaches, are subject to special conditions within the frame of legislation.

117. One of the mentioned conditions is that banks examine potential unfavorable effects on their credit exposures and their "ability to withstand such changes" by means of stress testing. The "ability to withstand such changes" means, amongst other measures, that the banks' available capital resources cover credit risks for the credit portfolio derived from a particular stress scenario. Stress testing in this case consists of "identifying possible events or future changes in economic conditions that could have unfavorable effects on an institution's credit exposures". Within the frame of IRB legislation, stress test is designed to address the effect of certain specific conditions, including at least mild recession scenarios, on its total capital requirements for credit risk. Since those capital requirements could change depending on the stage within the economic cycle, those stress tests should show the potential impact on capital requirements. The stress tests could, thus, show the need for possible action on the part of the bank, including the possible need for an increase in own funds.

117A. In terms of ICAAP, a bank should ensure that it has sufficient capital to meet the Pillar 1 requirements and the results (where a deficiency has been indicated) of the credit risk stress testing mentioned above.

118. Banks should assess the impact of ratings migration or changes in PD on capital requirements with respect to the economic cycle. This could include a significant and sustained deterioration in the economic climate. To this end, banks should consider a range of stress tests and scenario analyses which may go beyond a mild recession. It is up to banks to determine how this translates into specific risk drivers and how these risk drivers in turn affect a bank's total capital requirements for credit risk.

119. The result of the stress test has no direct effect on capital requirement and does not necessarily mean an additional requirement (i.e. extra capital or other measures), for example, to the extent that:

- banks are dealing with products or counterparties that can be shown to be countercyclical;

- banks can demonstrate credible management actions which can counter potential capital deficits; or

- if the economy is already in a recession (however, there may be repercussions under ICAAP).

120. In top-down stress testing, credit pools are formed from loans having similar features (internal rating, collateral quality etc) and the statistical relation (for example through regression) between the variables in the scenario and historical data of credit pools is determined. PD and LGD are obtained on credit pools basis and thus net loss projection is reached at. Current and forward-looking calibration of the model and the fact that reverse stress testing is made by the bank's own internal loss data are important aspects for the usage test. Although top-down stress testings are applicable for portfolios having similar risk aspects like retail loans and credit cards, they can only be applicable as subordinated for portfolios like commercial loans and project financing.

121. Bottom-up stress testing is applied on credit or counterparty (debtor) basis. The statistical relation between the risk drivers of a specific sector or loan class and variables in the scenario are put forward. Migration possibilities and matrix on credit exposure degrees are obtained on portfolio, product, sector, collateral type basis. Thus, stressed PD is reached at from debtor and collateral information. Furthermore, LGD is calculated as a function of elements such as collateral type, default timing, collateral value curve shift and amortization and such expenditures of collateral. It is important to use the mentioned analysis on debtor basis in risk-based pricing, budget and planning, economic capital modelling as well as risk appetite and limit setting.

122. On the other hand, calibration of the models based on cash flow corrected as to credit exposure is not possible if debtor's financial reports as well as default and loss data are not existing in the bank during an economic cycle. Actuary models used in the determination of credit exposure degrees transition matrix, default, bankruptcy, loss frequency and amount cannot detect the time of those parameters. Accordingly, developing an internal model supported by information from third parties, model and model calibration techniques can be an alternative solution.

123. In the calculation of credit loss parameters relating to mortgaged claims, factors such as Credit Registration Bureau(KKB) score, parameters relating solvency parameters of loan debtor (loan-income ratio, previous payment behaviors, purpose of loan, age of loan), parameters relating to early payment of loan and collateral value (loan collateral ratio), nature of real estate (commercial or residential, land, within or not municipality territory) and value indexes relating to region of the real estate.

Financial collateral values (in connection with large exposures)

124. Banks using the comprehensive method may identify conditions which would adversely affect the realizable value of the specific collateral held by the bank including deterioration in the credit quality of collateral issuers or market illiquidity. In doing this, banks are taking account of the specific characteristics of the financial collateral they hold.
125. Banks using the comprehensive method for calculating the effects of financial collateral, or permitted to use their own estimations of LGDs and conversion factors, may identify conditions which would adversely affect the realizable value of their financial collateral.
126. Events which may affect the realization of the collateral's estimated value, such as a decrease in the credit quality of the collateral issuers or market illiquidity which impacts the liquidation period, may be taken into account when calculating the effects of financial collateral for those banks using the comprehensive method based either on supervisory volatility adjustments or on their own estimates of volatility adjustments The potential for such events to occur may be determined by banks based on the type of financial collateral used. Different assumptions may legitimately be used for sovereign debt collateral and equities/convertible bonds collateral. Other examples which may affect the financial collateral's estimated value include currency mismatches between exposure and financial collateral, arrangements for marking to market1 and the realization of value from large amounts of financial collateral from a single source in a 'distressed sale'.

127. Where the results of the stress testing indicate a lower realizable value of the collateral, the value of collateral taken into account for the purpose of determining a bank's large exposure limits should be adjusted accordingly. To avoid such adjustments, banks may think it prudent to ensure that an appropriate margin over the collateralized exposure is maintained. This margin would cover fluctuations in the market value of the collateral to ensure that it does not fall below the reported level

VII.4. Counterparty risk

128. Enhancing stress testing approaches for highly leveraged counterparties is appropriate when considering vulnerability to specific asset categories or market movements and when assessing potential wrong-way risk related to risk mitigating techniques.

129. Banks may have large gross exposures to leveraged counterparties including hedge funds, financial guarantors, insurers, investment banks and derivatives. Under normal conditions, these exposures are typically completely secured by posted collateral and continuous re-margining agreements yielding zero or very small net exposures. In cases of severe market shocks, however, these exposures may increase abruptly and potential cross-correlation of the creditworthiness of such counterparties with the risks of the assets being hedged may emerge (i.e. wrong-way risk). Banks may enhance their stress testing approaches related to these counterparties in order to capture adequately such correlated tail risks.

VII.5. Operational risk

130. Regardless of the choice of approaches (i.e. Basic Indicator Approach, Standardized Approach or the Advanced Measurement Approach (AMA)), banks must adequately stress their operational risks. Besides, in the AMA some requirements already include stress testing components.

131. The stress assumptions for operational risk may be different from the ones used in credit and market risk stressed scenarios. These assumptions should be based on external (for example damage to tangible assets due to a natural disaster) and internal events (such as new products, systems, areas of

[1] Defines contracts to include market value-associated provisions relating to collaterals.

business and outsourced activities.). Especially in new areas with a lack or scarcity of loss data, stress tests may be based on scenario analysis.

132. A robust analysis of major operational risks includes stresses and analyses of historical and hypothetical operational risk events and assessments of the adequacy of the capital calculated against these stressed events.

133. Stress tests may be based on severe, but plausible, operational risk events. Historical and plausible hypothetical operational risk events (e.g. rogue trader scenarios, natural disasters) used for stress testing have the nature of low frequency and high severity. The stressed operational risk exposure in Pillar 2 should also take account of the overall operational risk exposure.

134. The analysis of operational risks may be based on a top-down or bottom-up assessment of the risk or may comprise both elements. The chosen approach should be consistent with the size and complexity of the business.

135. The analysis of the stress test events could involve expert opinion and include the macro-economic environment (e.g. to reflect increasing fraud risk in an economic downturn) and other external risks and factors.

Following paragraphs shall be considered by banks having AMA infrastructure and reporting their AMA results to senior management.

136. Four elements (internal and external data, scenario analysis, and business environment and internal control factors) shall be used in AMA. Through those four elements, all operational risk amounts shall be taken into account and all significant risk exposures shall be captured. If the AMA is used together with a simpler approach (Partial Use) to calculate the operational risk capital requirements, the stress test results for the latter should be added to the stressed AMA capital within Pillar 2.

137. Stress tests based on internal and external data may consider the occurrence of additional severe tail events, carefully analyze the boundaries of operational risk losses (e.g. large losses which are related to market risk are to be considered in the scope of the capital requirement for operational risk, for example, rogue trading due to sharp falls in market values), use scaling factors (e.g. in a situation where external data were scaled down, the scaling may be reduced or the data may even be scaled up accounting for, e.g., expectations on increasing inflation rates) and the criteria for determining the relevance of data (e.g. large loss data considered not to be relevant may be used within the stress test).

138. Banks also stress their business environment and internal control factors, as well as considering macroeconomic developments and other relevant external factors.

139. Stress tests may include scenario analysis as an input to the model for extreme values (e.g. by assuming combined scenarios, an increasing number or probability of high severity events, or taking into account possible chain reactions and possible effects on/of other risk types).

VII.6. Liquidity risk

140. It should be noted that liquidity risk has two dimensions:

- funding liquidity risk: the current or prospective risk arising from a bank's inability to meet its liabilities/obligations as they fall due without incurring unacceptable losses; and

-market liquidity risk: the risk that a bank cannot easily offset or sell a position without influencing the market price because of inadequate depth in the market or market disruption.

141. Each bank is expected to manage its individual funding liquidity risk, taking into account the possible impact of market liquidity risk.

142. All material liquidity risk drivers are expected to be considered in identifying the potential liquidity gap. The drivers incorporate both asset and liability side factors. The methodology used for calculating the shock effects is to estimate the net cash flows. For each scenario, at each stress level, the bank identifies cash inflows and outflows that can be expected to occur in each future time period and the resulting net cash flows.

143. Liquidity risk arises for two sets of reasons, liability side and asset side. The liability side reasons include diminishing ability to raise new funding, failure to roll over liabilities and withdrawal risk (e.g. unforeseen withdrawal of deposits). The asset side (on– and off-balance sheet) reasons include the unexpected utilization by customers of committed credit lines, back-up/stand-by facilities and other lending facilities. In asset side scenarios declines in market liquidity and/or value of liquid assets may also have to be taken into account as they determine the amount of liquidity a bank is able to generate from them. Asset side shocks could also cause declines in asset values which might lead to liquidity stress through margin calls (when those assets are pledged).

144. In each scenario at each stress level there are two types of cash flows that can be expected to occur, the contractual cash inflows and outflows, either discretionary or non-discretionary, e.g. liquidity drains from margin calls and required posting of collateral; and the cash inflows and outflows resulting from customer behavior. They may also cover the following, where applicable:

- impact of covenants - downgrade triggers;

- impact of non-contractual liquidity support (reputation-linked); and

- impact of liquidity back-up facilities.

145. By summing up all the cash flows a bank may end up with the forecast liquidity requirement for each time period in each scenario at each stress level. It may then calculate the net cash flow for each time bucket in each scenario at each stress level. This is the amount by which the forecast cash inflows exceed (or fall short of) the forecast outflows. Potential liquidity gaps are identified and quantified through liquidity stress testing in specified stress scenarios, as well as means of closing those gaps and the funding cost. The liquidity gaps are created by loss of available funding (e.g. reduction in deposits) and/or increased demand for liquidity (e.g. funding contingent liabilities). The bank may define the different ways at its disposal to close those gaps according to the scenario contemplated (unsecured funding if assumed to be available, secured funding). Changes of business structure like reducing credit expansion may be contemplated for long-lasting stress scenarios depending on the business model of the bank. In each case the funding cost is an important parameter.

146. Three types of stress scenarios are expected to be applied: idiosyncratic, market-wide, and a combination of the two. The idiosyncratic stress might assume no rollover of unsecured wholesale funding and some outflows of retail deposits. In addition, a typical bank-specific scenario is, for example, a downgrading of a bank's debt instruments (including SPV issued CP) by external rating

agencies. The market-wide stress might assume a decline in the liquidity value of some assets and deterioration in funding market conditions. In addition, market stress scenarios can involve market disruptions or changes in the macro-economic environment in which the bank is operating, or the downgrading of countries in which the bank is operating.

147. While stress testing is applied, both bank-peculiar vulnerabilities and the ones related with systemic events and cases can be defined. An effective test must define and quantitate the depth, source and degree of potential liquidity squeeze and funding difficulty; and analyze their possible impacts on cash flows, liquidity position, profitability and other issues relating to financial status as of different time frames. For example, stress testing is expected to include potential funding deficits, possible decreases in liquid assets or conversion into liquid, removal of borrowing ability, impact of possible deposit withdrawals, high volatility in short-term money market borrowing facilities, funding sensitivity of the decrease in ratings and a decrease in the value of assets having the nature of collateral in borrowing markets (CBRT, Takasbank or over-the-counter markets beside organized markets like Borsa Istanbul).

148. To provide a complete view of the various risk positions, stress testing of other risks are considered in constructing 'alternative liquidity scenarios'.

149. Banks increasingly rely on funding sources that are more sensitive to interest rate, market, credit, and reputation risks. Therefore, in assessing stress testing scenarios the impact of other risks on liquidity risk may be considered. As these other risks can generate liquidity drains (through increased funding costs or through margin calls or required posting of collateral, for example), sound management of these risks helps but does not provide sufficient liquidity risk mitigation.

VII.7. Interest rate risk for banking accounts

150. For the purposes of these guidelines, interest rate risk is the exposure of banks' positions to adverse movements in interest rates. Positions in the trading book are considered as an element of market risk and only the positions in banking book will be considered under this title.

151. All sources of interest rate risk in the banking book are relevant for stress testing interest rate risk in the non-trading book, namely,` re-pricing risk, yield curve risk, basis risk and option risk.

152. However, the purpose of this section is to demonstrate that a simple parallel shift of yield curve may not suffice. Therefore, banks may have to consider movements and changes in the shape of their yield curves in their scenario analysis, as a non-parallel shift in the curve can entail additional declines in both the net interest income and the economic value of a bank.

153. In adverse situations, the holder of an embedded option may make use of the right to terminate the contract early, which can force the bank into a new transaction on less favorable terms.

154. The complexity of interest rate risk varies from bank to bank with regard to the sophistication of the financial instruments used. Where less complex financial instruments are employed, the effect of a shock can be calculated by the bank using sensitivity analysis (without identification of the origin of the shock, and by means of the simple application of the shock to the portfolio). Where a bank uses more complex financial instruments on which the shock has multiple and indirect effects, it should use more advanced approaches with specific definition of the adverse (stress) situations.

VII.8. Concentration risk

155. Concentration risk defines serious loss-bearing probability of different risk types (both intra- and inter-risk) depending on many factors in a manner to prevent sound operating of the bank or change the bank's profile.

156. Since stress tests are made to reveal the relations between risk elements and their effects on the bank's financial status under adverse economic conditions, the issues relating to concentration risk comprise a significant dimension of stress testing system.

157. Stress testing is a key tool in the identification of concentration risk. In addition, stress testing would allow banks to identify interdependencies between exposures, which may only become apparent in stressed conditions as well as hidden concentrations, even though the probability of such adverse scenarios is significantly low.

158. In stress testing, especially firm-wide stress testing, banks could identify risk concentrations taking into account single risk concentrations and interrelated risk types considering on- and off-balance sheet exposures, as well as banking, trading and hedging positions.

159. Stress tests are expected to take into account changes in the business environment that may occur which would lead to risk concentrations materializing. In particular, stress tests may consider unusual but plausible changes in correlations between various types of risk drivers as well as extreme and unusual changes in risk parameters, going beyond single risk drivers or risk types, to look at scenarios that take account of interrelated risk drivers and that feature not only first round effects but also feedback effects.

160. The link between a macro-economic scenario and the impact on a particular concentrated risk factor, such as geographic region or industry sector can be identified. The way in which concentrated exposures perform in response to the same risk drivers may be factored into the stress tests, including the risk of short-term large increases in losses as a result of concentrated exposures across, say, the retail and corporate credit books or across different entities in a group.

161. Banks would also consider inter-risk concentrations, aggregating across risk types notably market and credit risk, to gain a better understanding of their potential credit, liquidity and trading book risk concentrations in a stress. Banks may identify potential links between exposures and question assumptions about correlations between risk types in a stress.

162. Banks may have to consider these correlations in extreme events and question what confluence of events could lead to correlations of such magnitude that they would threaten the viability of the bank. It is in this regard that banks may have to consider the use of reverse stress testing that would allow them to test the plausibility of the assumptions that have been made for main case business planning. Analysis of unlikely but still plausible events that lead to unusual correlations allows the bank to consider in its risk analysis and mitigation program.

163. Stress tests are expected to be performed both on a solo basis for individual legal entities - in order to take account of potential risk concentrations specific to local markets - and on a consolidated basis on the type of concentrations that can materialize at group level. The results of concentration risk stress tests could be communicated within the bank and used in decision making processes and limit setting as part of concentration risk management.

164. This guideline shall enter into force in the publication date. The Guideline on Stress Testings to be Used by Banks in Capital and Liquidity Planning (Board Nr. 5964, dated July 24, 2014) is hereby abolished.

ANNEX-I DEFINITIONS

Ad hoc stress testing: Non-periodical stress testing made specially in case of a development or when needed.

Loan-to-value ratio (LTV): The ratio of a loan to the value of an asset purchased.

Non-linear products: Financial instruments comprising option.

Contingency plans: The plan of decisions to be implemented by the bank management under stressed conditions.

Gapping of prices: A significant price movement of a traded financial instrument between two transactions or trading sessions.

Tail risk: Realization possibility of extreme values of probability distribution.

Plausible but exceptional event or situation: Occurrence of scenario assumptions from consistent and coexisting events and situations however, at the same time, comprising rare events and conditions compelling the existence of the bank.

Material risk: Risk type bearing high loss probability when compared to regulatory capital of the bank.

Time horizon: Period comprising the stress testing program and predicted for how long the stressed conditions will continue.

Implicit support: Although not based on a clear contract, liquidity, capital or a similar support given for reputation or other reasons to another natural person or legal entity so as to reduce actual and potential losses of securitization position investors.

Risk driver- risk factor- risk type: Key condition for analyzing the risks exposed by the bank is to categorize the risks. Within the scope of this guideline, risk types are used as the most comprehensive classification unit. Each risk type comprise similar or different, more than one risk factors. Factors increasing loss possibilities on risk factors are defined as "risk driver".

Range of scenarios: The scenario set including different variables and/or severity.

Severity: Deviation level of scenarios determined within the scope of stress testing program from the expected trends.

One way markets: Markets comprised of only buyers or only sellers or where quotations are only entered downwards (purchase) or upwards (sales).

Margining requirements: Requirement of the bank to meet the collateral need arising as a result of valuation within the frame of the contracts to which the bank is a party.

Trigger: Threshold values where some conditions in the contracts to which the bank is a party are effectuated and give a right or burden an obligation to parties in parallel with contract provisions.

Level of aggregation: All scales to be handled around one or more than one risk factor or type starting from a single financial instrument or position to whole bank on consolidated level.

Expert judgment and statistical method: Expert judgment defines developing a calculation model with the highlight of experts' intuitive approaches based on experiences, statistical method defines developing by using statistical techniques from a data set.

Top down and bottom up approach: Bottom up stress testing defines separately aggregation of stress testing results relating to certain loss possibilities and risk factors while top down stress testing defines distribution of firm-wide stress testing result to business lines and/or partnerships.

ANNEX-2 STRESS TESTING REPORT

1. Risk Definition and Measurement

Under this title, risk types analyzed in stress testing program are lined and the changes in raw and produced data until it becomes a final input into stress testing model (data producing process) are determined.

a. External variables (macroeconomic, financial etc.)

b. Nature of external data (resource, period and characteristic features - from which market, when, what type (average, maximum, minimum etc.), on which basis (n/360, n/365), in which interest type (simple/compound) etc.)

c. Internal variables (loans, securities, wholesale funding etc.)

d. Nature of internal data

e. Legal and administrative limitations (CAR, liquidity ratios, FXNGP/ Own fund ratio, BHFOR standard shock ratio, credit limitations, internal risk limits etc.)

f. Decisions made on activities and capital structure on bank and unit scale and action plans matched with critical levels

g. Fundamental risks of the bank

2. Structure and documentation of model

a. Features of software, databases and variables (information will be given within the scope of "5.1.2 Risk measurement" of the Guideline on ICAAP Report.)

b. List of reference documents relating to simulation and/or calculations in the model (academic articles and books in the literature, technical documents of expert administrative and commercial institutions)

c. Evaluation (advantages, weaknesses and limits), calibration, validation and back testing of the model

3. Capital and liquidity adequacy analysis (Model's implementation)

In the case that a stress testing methodology in which mainly qualitative evaluations and expert views are implemented, results may not be reached at concerning some of the below-mentioned issues.

a. Scenario range produced

b. Predictions on risk factors obtained by using the scenario

c. Internal risk parameters obtained from predictions concerning risk factors

d. Capital losses, pre-provision net revenue projections (net interest income, net non-interest income etc.) obtained from internal risk parameters

e. Cash flow models (considering early payments and defaults) and loss amount (setting aside provisions for economic losses) concerning assets

f. Analysis on deposit attrition

g. Results of liquidity and operational risk models (liquidity attrition from deposit, liquidity value of assets, analysis on rollover)

h. Latest interim and aggregated outputs of the model

4. Results of the methodology

Stress testing outputs shall be associated with the below-mentioned measures and produced in the same type of them as far as possible.

a. Statutory capital adequacy ratios (buffers calculated within the frame of the Regulation on Measurement and Evaluation of Capital Adequacy dated 28.06.2012 Nr. 28337 and sub-regulations thereof as well as the Regulation on Capital Protection and Cyclic Capital Buffers dated 05.11.2013 Nr. 28812)

b. Leverage ratio (buffers calculated within the frame of the Regulation on Measurement and Evaluation of Banks' Leverage Levels dated 05.11.2013 Nr. 28812)

c. Internal capital adequacy and capital planning buffer

d. RAROC (Risk-Adjusted Return on Capital)

e. LCR (Liquidity Coverage Ratio)

f. NSFR (Net Stable Funding Ratio)

- AFS (Available Stable Funding)

-RFS (Required Stable Funding)

-Risk of Ruin

g. Operational risk criteria