

**INTERNATIONAL ASSOCIATION OF
INSURANCE SUPERVISORS**



**STRESS TESTING BY INSURERS
GUIDANCE PAPER**

October 2003

[This document was prepared by the Solvency Subcommittee in consultation with members and observers.]

Stress testing by insurers

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1. Introduction

1. The IAIS adopted a paper in January 2002 entitled *Principles on capital adequacy and solvency*, which sets out principles that should underlie solvency regimes for the regulation and supervision of insurers, including principles regarding the level of solvency. This guidance paper on stress testing most directly addresses *Principle 10*:

- *Principle 10: Capital adequacy and solvency regimes have to be supplemented by risk management systems.*

However, stress tests are also relevant to many other principles, such as:

- *Principle 1: Technical provisions of an insurer have to be adequate, reliable, objective and allow comparison across insurers*
- *Principle 3: Assets have to be appropriate, sufficiently realisable and objectively valued*
- *Principle 4: Capital adequacy and solvency regimes have to address the matching of assets with liabilities*
- *Principle 5: Capital requirements are needed to absorb losses that can occur from technical and other risks*
- *Principle 6: Capital adequacy and solvency regimes have to be sensitive to risk*

- *Principle 7: A control level is required*
- *Principle 11: Any allowance for reinsurance in a capital adequacy and solvency regime should consider the effectiveness of the risk transfer and make allowance for the likely security of the reinsurance counterparty*
- *Principle 12: The capital adequacy and solvency regime should be supported by appropriate disclosure*
- *Principle 13: Insurance supervisory authorities have to undertake solvency assessment.*

2. In addition, the *Insurance core principles and methodology (2003)* includes the following:

- ICP 18 (Risk assessment and management):
The supervisory authority requires insurers to recognise the range of risks that they face and assess and manage them effectively.
- Advanced criterion in ICP 20 (Liabilities):
The supervisory authority requires that insurers undertake regular stress testing for a range of adverse scenarios in order to assess the adequacy of capital resources in case technical provisions have to be increased.

3. Stress tests are a necessary tool in assisting an insurer to manage its risks and maintain adequate financial resources to deal with those risks. Stress tests can be used to identify and quantify the impact of different stress scenarios on an insurer's expected future financial position, in the broad sense.

4. Stress tests are a tool for examining what might happen in a particular stress scenario. However it should be noted that they do not predict what will happen.

5. The purposes of this guidance paper are:

- to discuss the role stress tests should play in an insurer's overall risk management framework, and how such tests may assist the insurer to maintain sufficient capital adequacy and solvency
- to outline the important role stress tests play in assisting supervisors to undertake their role in assessing risks faced by insurers
- to outline how supervisors can use stress testing to assess the prudential strength of individual insurers
- to outline the supervisory considerations, such as the corporate governance regime, that need to surround an insurer's stress testing environment
- to provide an overview of the various factors that need to be considered in designing and undertaking stress tests, including a discussion of possible modelling techniques that can be used.

6. The purposes of this guidance paper are not:

- to show how stress testing can be used to assess the stability of the insurance sector or financial system as a whole
- to prescribe the form and extent of public disclosure of insurers' stress testing results
- to define the corrective measures that can be taken by supervisors.

2. Objectives of stress testing

7. The business of insurance is based on dealing with uncertainty. Therefore, an insurer needs to consider a wide range of possible outcomes that may affect its current and expected future financial position. Stress tests are a necessary risk management tool for both insurers and supervisors to ascertain whether insurers are financially flexible to absorb possible losses that could occur under various scenarios. All the effects of stress testing, both direct and indirect, on both sides of the balance sheet should be taken into account.

For insurance management

8. Stress tests are a necessary tool for insurance management. Such tests should be a fundamental element of an insurer's overall risk management framework and capital adequacy determination. Stress tests are appropriate tools for insurers to use in assessing the risks to which they are subject and in ascertaining their own limits on the risks that they are prepared to take. They should help the insurer in making decisions as to whether, and what, action is needed to ensure that it is not taking undue risks from its own or the supervisor's and policyholders' perspective. For many insurers, this may require a cultural change in their approach to risk management.

9. It is expected that prudent, well-managed insurers would undertake stress testing as a matter of good corporate governance, which should result in better internal controls, governance and risk management. To be truly effective, stress tests should be considered as a fundamental element in an insurer's overall risk management framework, rather than being viewed simply as a helpful tool for capital allocation purposes or as a way to monitor performance. The use of such tests should not be seen as a regulatory burden.

10. Stress testing should contribute to the understanding that the board and management has of the risks facing the insurer. To accomplish this, the board and management must understand the assumptions underlying the stress testing, as well as the results. Also, stress tests can help an insurer to develop and assess alternative strategies for mitigating its risks.

11. Specifically, such tests should be appropriate to the insurer's own risk profile. For example, stress tests should reflect the fact that each insurer does not underwrite the same classes of risks, accept the same level of risks, have the same distribution systems, employ the same reinsurance arrangements, have the same distribution of assets by investment type/grade or have the same operational systems and controls.

12. The stress testing should address significant adverse threats to the future financial condition of the insurer, rather than just mildly uncomfortable possibilities, so as to truly test the insurer's exposure and the sufficiency of its technical provisions and capital. To better inform the board and management of the insurer's exposure to risks, it is useful to determine how adverse a risk must be for it to impair the insurer's financial position. The insurer should use stress testing for strategic planning and for contingency planning.

For the supervisory process

13. The supervisor should receive the results of the most material stress tests and the critical assumptions underlying them, and have access to the results of all tests.

14. Where the supervisory authority considers that the stress tests conducted by the company should be supplemented with additional tests, they should be able to require that the insurer carry out such additional tests. Where the supervisor feels that the company's response to the results of the stress test is insufficient, it should be able to direct the company to develop a more prudent response.

15. There are circumstances where the supervisor may develop standard stress tests and require insurers to perform such tests. One purpose of such testing is to measure the level of consistency in the testing done by the insurers and thus to enhance the confidence in the stress tests performed by the insurers. Such tests may be directed at a single insurer, selected insurers or all insurers. The criteria for scenarios used for standard stress tests should be developed such that the risk environment of each jurisdiction is duly taken into consideration.

16. In some countries, in determining capital requirements, some degree of stress testing is required. In such cases, it would be expected that the level of risk tested is set at a level well below what is expected to be used in the more general stress testing addressed by this paper.

3. Scope of coverage

17. There are numerous definitions of what constitutes stress testing. For the purposes of this paper, the term "stress testing" includes both sensitivity testing and scenario testing. Both approaches are undertaken by insurers to provide a better understanding of the vulnerabilities that they face under atypical conditions. They are based on the analysis of the impact of unlikely, but not impossible, adverse scenarios. These stresses can be financial, operational, legal, involve liquidity or be related to any other risk that might have an economic impact on the insurer.

18. Specifically, a sensitivity test estimates the impact of one or more moves in a particular risk factor, or a small number of closely linked risk factors, on the future financial condition of the insurer. An example of a sensitivity test is the resiliency testing done in the U.K. and Australia. A scenario test, by comparison, is a more complicated type of test, which contains simultaneous moves in a number of risk factors and is often linked to explicit changes in the view of the world. Scenario tests often examine the impact of catastrophic events on an insurer's financial condition, particularly in a defined geographical area, or simultaneous movements in a number of risk categories affecting all of the insurer's business lines or trading operations, e.g., underwriting volumes, equity prices and interest rate movements.

19. There are two basic types of scenarios: historical and hypothetical. Historical scenarios reflect changes in risk factors that occurred in specific historical episodes. Hypothetical scenarios use a structure of shocks that is thought to be plausible, but has not yet occurred. Each type of scenario has its benefits. Depending on the risks, both approaches could be of value and should thus be used.

20. A large part of an insurer's financial management is based on an understanding of expected outcomes and the normal variation around these expected outcomes. An analysis of the financial effects of atypical or extreme scenarios is needed to gain a comprehensive view of the risk assumed, e.g., measuring the potential impact of a stock market collapse on the insurer's equity portfolio.

21. To measure the effects of atypical or extreme movements, there are numerous techniques that can be used in stress testing. These include deterministic modelling and various types of stochastic modelling¹, including Monte-Carlo simulation approaches. The risks that are stress tested must be

¹ The used of the word "stochastic" in this paper refers to both very sophisticated, complex methods, as well as to more simple models with a small number of random variables.

described and measured, including non-linear, asymmetric risks, such as options and prepayment risks. Various modelling techniques are discussed in Section 7 of this paper.

4. Required expertise

22. Each insurer should have access to the expertise and technology required to design and perform stress tests. This may involve a specialised risk management unit, actuarial personnel or external consultants.

23. Various individuals within the insurer, such as risk managers, finance personnel, actuaries and business line managers, should be involved in designing the stress tests. It may also be useful to consider other views, for example, those of the supervisor, external consultants, the accounting and actuarial professions, the reinsurance industry and rating agencies.

24. Those involved in designing the stress tests should have:

- a mix of expertise, which includes actuarial, accounting, economic, legal and financial expertise
- a thorough understanding of the business of the insurer
- the ability to identify risks that could potentially have a material adverse impact on the insurer's financial position
- the ability to undertake an analysis of how much of an impact these risks could reasonably have
- an understanding of the various models that can be used.

25. Those carrying out the testing must have the ability to analyse and effectively communicate the results.

26. Regardless of the level of expertise of those involved in designing the stress tests, a level of independence should exist to ensure that an adequate set of tests has been designed that is appropriate to the risk profile of the insurer. The decisions about the factors to be considered and the tests undertaken should be made, if possible, by those who are not involved in the corresponding business decisions. For a small insurer, it may be difficult to fully separate the decisions on stress testing from those involved in business operations.

27. In turn, insurers would be expected to be able to understand the results of the stress testing and to determine whether any aspect of their operations should be changed, given this knowledge.

5. Designing stress tests

28. It is appropriate that each insurer design its stress tests considering its own risk profile and the complexity of its business. It is likely that this will lead to variation among insurers as to the extent and nature of the tests performed.

29. There is benefit in considering stress scenarios even for risks that cannot be easily quantified or modelled. Examples of such risks include court rulings dealing with claims practices, reputational risk, changes in tax laws, etc.

30. Despite their limitations, supervisors may require, from time to time, some standardised tests in order to obtain a measure of consistency and for baseline monitoring purposes. These tests, however, should neither inhibit an insurer from undertaking its own thorough review of the inherent risks in its business, nor discourage an insurer from adopting an effective, comprehensive, risk-based approach to business management.

31. Various considerations are likely to determine the nature and extent of tests required. They include the insurer's:

- solvency position
- lines of business and distribution systems
- current position within the market
- current position within the group
- investment policy
- business plan
- general economic conditions.

For example, an insurer with a low solvency position should conduct more extensive or more frequent stress tests. An insurer within a larger corporate group should test the effects of possible changes resulting in constraints to accessing additional capital.

32. The insurer should consider what events are material, having regard to their impact and likelihood or plausibility. This, in part, will be a function of the insurer's size, complexity, solvency position and the nature of its operations and will depend on the insurer's risk tolerance.

33. The insurer should be able to withstand circumstances that are reasonably foreseeable, albeit unlikely, including events for which it is providing specific coverage.

34. In terms of specific elements, the following factors could be used as a guide to what insurers might consider when developing their stress tests. It should be noted that this is not intended to be an exhaustive list, especially as prescribed minima cannot cover all the specific risks within an insurer. Professional associations, such as an actuarial association, may also provide guidance on factors to be considered in developing stress tests.

Insurance risks

35. Insurance risk relates to the risk that an inappropriate underwriting strategy is adopted (e.g., involving an inappropriate pooling of risks and adverse selection), that the chosen strategy is inadequately implemented, or that unexpected losses arise even when an appropriate strategy is adequately implemented. Insurance risks specifically focus upon the impact of the underwriting and claims functions on an insurer's premiums and technical provisions. Insurance risks may be categorised as underwriting risk, catastrophe risk, or the risk of deterioration of technical provisions. Factors to consider include, but are not limited to:

Underwriting risk

36.

- the adequacy of the insurer's pricing, e.g., the insurer should be able to satisfy itself that it can charge adequate rates, taking into account the business, the terms of the policies, any options or guarantees, the premium cycle's effect on industry capacity and rate-levels and its own internal profit targets
- the effects of rapid growth or decline in the volume of the underwriting portfolio
- the uncertainty of claims experience, including the frequency and size of large claims
- the length of tail of the claims development and latent claims
- the dependence on certain intermediaries for a disproportionate share of the insurer's premium income
- the possibility of reinsurance rates increasing substantially or reinsurance becoming unavailable
- the effects of a high level of uncertainty in pricing in new or emerging underwriting markets due to a lack of information needed to enable the insurer to make a proper assessment of the price of the risk
- the geographical mix of the portfolio and any geographical or jurisdictional concentrations
- the tolerance for variations in expenses, including indirect costs, such as overheads.

Catastrophe risk

37.

- the ability of the insurer to withstand catastrophic events, increases in unexpected exposures, latent claims or aggregation of claims
- the possible exhaustion of reinsurance arrangements
- the appropriateness of the catastrophe models and underlying assumptions used, such as probable maximum loss (PML) factors.

Catastrophic events apply to all lines of business.

Deterioration of technical provisions

38.

- the adequacy and uncertainty of the technical claims provisions, e.g., outstanding claims, incurred but not reported claims (IBNR) and claims handling expense reserves
- the adequacy of other underwriting provisions, e.g., the provisions for unearned premiums and unexpired risks
- the frequency and size of large claims

- possible outcomes relating to any disputed claims, particularly where the outcome is subject to legal proceedings
- the effects of inflation
- the effects of increasing longevity on pension products
- the guarantees and options in policy terms
- the risks of early policy termination which can be linked to variations in interest rates
- social changes resulting in an increase in the propensity to claim or to sue
- other social, economic, legislative and technological changes.

Market risk

39. Market risk is concerned primarily with the adverse movement in the value of an insurer's assets and liabilities, both on-balance sheet and off-balance sheet, whose value may be affected by market movement. For insurers, it is the extent to which an adverse movement in the value of the assets as a consequence of market movements, such as interest rates, foreign exchange rates, equity prices, etc., is not offset by a corresponding movement in the value of the liabilities. Factors to consider include, but are not limited to:

- the possibility of a severe economic or market downturn leading to interest rate movements that adversely affect the insurer's financial position
- the impact of price shifts in asset classes on the entire portfolio
- inadequate valuation of assets
- the direct impact on the portfolio of currency devaluation, as well as the effect on related markets and currencies
- the extent of any mismatch of assets and liabilities, including reinvestment risk
- the impact on the portfolio value of a dramatic change in the spread between a market index of interest rates and the risk free interest rate
- the extent to which market moves could have non-linear effects on values, e.g., derivatives
- the effect of credit rating downgrades on the value of assets.

Credit risk

40. Credit risk relates to the possibility that a counterparty will fail to perform its obligations. Insurers' counterparties may include debtors, borrowers, brokers, policyholders, reinsurers and guarantors. Credit risk may also be assumed through guarantees and other financial instruments, such as derivatives and securitisations. Factors to consider include, but are not limited to:

- the collapse of a reinsurer or several reinsurers on the insurer's reinsurance program and the subsequent impact this may have on outstanding reinsurance and IBNR recoveries
- a deterioration in the credit worthiness of the insurer's reinsurers, intermediaries or other counterparties
- the degree of concentration of business with reinsurers of particular rating grades
- the degree of credit risk concentration, e.g., exposure to a single name or counterparty
- deterioration in the extent and quality of collateral
- greater losses from bad debts than anticipated
- defaults by parties in respect of whom guarantees have been given by the insurer, whether under insurance contracts or otherwise.

Liquidity risk

41. Liquidity risk relates to the possibility that an insurer will be unable to realise assets to fund its obligations as and when they fall due. Understanding whether an insurer's cash flow is sufficient to meet its commitments to policyholders and other creditors is fundamental. Factors to consider include, but are not limited to:

- any mismatch between expected asset and liability cash flows
- the inability to sell assets quickly
- the extent to which the insurer's assets have been pledged
- the cash-flow positions generally of the insurer and its ability to withstand sharp, unexpected outflows of funds via payment of claims, or an unexpected drop in the inflow of premiums
- the possible need to reduce large asset positions at different levels of market liquidity, and the related potential costs and timing constraints.

Operational risk

42. The *IAIS Glossary* defines operational risk as: "the risk arising from failure of systems, internal procedures and controls leading to financial loss. Operational risk also includes custody risk." This paper uses the term in a wider sense than the present Glossary definition.

43. While the application of stress tests to operational risks may not be immediately obvious, the insurer should at least be able to demonstrate that such risks have been considered and that appropriate plans and procedures exist to adequately deal with an adverse scenario. Operational risks may be very difficult to identify and measure. Factors to consider include, but are not limited to:

- the adequacy of an insurer's business continuity management (BCM) plans
- the adequacy of an insurer's disaster recovery planning (DRP), e.g., the potential failure of back-up systems, or failure in the efficiency and effectiveness of off-site back-up facilities

- the possibility of fraudulent activity occurring that may impact upon the financial condition or operational situation of the insurer
- the technological risks to which the insurer may be exposed, e.g., those relating to both the hardware systems and the software utilised to run those systems
- the reputational risks to which the insurer may be exposed, e.g., the impact on the insurer if its brand is damaged, resulting in a loss of policyholders from the underwriting portfolio
- the marketing and distribution risks to which the insurer may be exposed, e.g., the dependency on intermediary business
- the possibility of political interference, e.g., the confiscation of assets, restriction of movement of funds in an emergency situation or legislative changes, such as changes in taxation or mandatory coverages
- the impact of legal risks, e.g., the imposition of fines, or the risk that policy wording may be interpreted more broadly than intended
- the possible impact of any outsourcing difficulties, e.g., third-party providers failing to perform in accordance with their contractual obligations
- the failure of general personnel management controls, e.g., the impact of an underwriter exceeding authority limits.

Group risk

44. The membership of an insurer in a group can be a potential source of strength to the insurer, but it can also pose risks, particularly as a result of contagion. Factors to consider include, but are not limited to:

- the impact on the insurer if financial support is no longer being guaranteed by the parent or the insurer is unable to access additional capital or repatriate funds
- the effect on the insurer of an impaired parent or affiliate within the group, e.g., the impact on funding sources available, such as lines of credit, intra-group funding or access to external capital
- the effect on the insurer of the inability to sell or close a subsidiary in difficulty in a timely manner, e.g., where the subsidiary shares the same brand, systems and other infrastructure as the insurer
- the potential diversion of management time to group issues
- the implicit support of group companies through the reallocation of group overheads towards the insurance entity
- the pressure on the insurer to financially support other group members
- the pressure on the insurer to comply with group requirements rather than the firm's own strategy, e.g., with respect to investment mix

- the effect on the insurer of a high degree of dependence on group resources (e.g., through intra-group outsourcing) to support the insurer's critical operations
- the effect on the insurer of a downgrade in the rating of the group or of other reputational issues.

Systemic risk

45.

- the failure or downgrading of one or more significant insurer in a market could result in marketing or reputational risk for other insurers
- the failure or downgrading of other financial institutions, such as banks, in a jurisdiction could affect an insurer's operations.

6. Frequency and time horizon of stress testing

46. Stress tests should be conducted at least annually. In addition, stress tests should be conducted to capture new material developments and evolving portfolio characteristics. The decision on the appropriate frequency will be influenced by factors such as those mentioned in paragraph 31.

47. While it is normally appropriate to perform stress testing at least annually, less frequent stress testing may be appropriate for an insurer with a low risk profile. More frequent stress testing may be appropriate for an insurer with a high risk profile, or when market conditions are changing rapidly. Supervisors may require more frequent stress testing, e.g., quarterly, either as a general practice or in response to the particular circumstances of the market or an insurer. For such non-annual stress testing, the supervisory authority may require fewer details than is the case for annual stress testing.

48. Stress tests should examine the effects and impact that different time horizons will have on business plans, strategic risks and future operating requirements. The time horizon needs to be long enough for the effects of the stress to be fully evident, for management to act and for the results to emerge. For some risks, this may require stress testing over a complete economic cycle. For example, in Canada, life insurers project financial results for five years and non-life insurers for at least two years.

7. Modelling techniques used in stress testing

49. Various modelling techniques are used in stress testing. The use of a particular risk model will depend on the insurer's circumstances and approach to risk assessment and risk management. Common methods used are based on static or dynamic modelling and deterministic or stochastic approaches.

50. In its basic form, static modelling implies that the analysis of the insurer's financial position is at a fixed point in time, whereas dynamic modelling takes into account developments over a certain time period. Deterministic models examine the financial impact if a certain scenario occurs, whereas stochastic models also take into account the probability of various scenarios occurring.

51. A simple example of a static deterministic stress test is where an insurer, in determining its appropriate capital level, examines the effects of loss ratios on its balance sheet. The loss ratio is the

risk variable, and the impact on net assets is the resultant exposure. Such tests do not take into account the actual probabilities of the different loss ratios occurring.

52. Stochastic models are more advanced techniques. They are based on probabilities that predict how key financial parameters interact with each other over time, and generate a distribution of outcomes based on simulations of those parameters in the future. One of the advantages of stochastic modelling is that it provides an indication of the range and the likelihood of different financial outcomes occurring. This is useful in achieving a particular level of confidence in the solvency level, e.g., a 0.5% risk of ruin.

53. Stochastic models are useful, and at times essential, where the insurance contracts contain both embedded options and financial guarantees. In these circumstances, it is likely that stochastic modelling will be needed for financial statement purposes as well as for stress testing.

54. An example of a stochastic risk measurement technique is Value at Risk (VaR). VaR models, often used in banks, provide a probability-based boundary on likely losses for a specified holding period (e.g., 10 days to 1 year) and confidence level. TailVar (also known as Policyholders' Expected Shortfall) is more frequently preferred for modelling catastrophic type events. However, statistical models such as VaR have a limited ability to accurately capture what happens in exceptional circumstances or extreme events, since statistical inference is imprecise without a sufficient number of observations and, in any event, is based on extrapolation of past experience into an unknown future².

8. Model validation and documentation

55. The reliability of the models used should be regularly validated.

56. The choice of models and parameters requires judgment, and the reliability of results may be compromised by model and parameter error. Regardless of the models used by an insurer in its stress tests, periodic back-testing or other validation processes should be undertaken to verify results and ascertain the degree of accuracy within the models. Some related considerations are as follows:

- when stochastic models are used, an insurer should stress test assumptions and correlations to see how sensitive the results are to the assumptions and the model parameters. An error analysis should be carried out and considered when evaluating the results of the stress tests
- models should be reviewed by individuals not engaged in the development or regular use of the models, nor involved in the corresponding business decisions, and the results of such reviews should be documented
- robust change control procedures should be in place to ensure that model changes are identified, documented and audited
- there should be a process in place for ongoing analysis of changes in modelled results from one period to the next.

57. Back-testing is a process for validating the accuracy of a model against actual results. This analysis should demonstrate that actual results over a reasonable period of time are within the expected range produced by the models.

² While techniques exist under extreme value theory to better capture such risks, they are not yet widely used.

58. For many risks faced by an insurer, the potential degree and validity of back-testing may be limited. For example, analysing the stock market on an annual basis (in terms of an insurer's investment portfolio) may provide 100 years of data, but much of it is of questionable relevance. For legal changes, the relevance of historical analysis may be very limited. When catastrophic type events are analysed, models should be based more on the structure of the risk events than on past statistics only.

59. Models used for stress testing hedging and trading strategies should also be evaluated to identify critical assumptions, such as the nature and extent of a potential market move or the correlation assumptions used in pricing models.

60. The entire stress testing process should be well documented. A procedures manual should exist which:

- describes the basic principles of the stress testing approach
- documents the quantitative techniques used
- documents the design of the stress testing models
- lists the controls and procedures integral to the stress testing process
- describes the criteria used to determine the scenarios to be tested.

9. Complexity of scenarios and interactions among risks

61. The complexity of stress tests should be driven by the circumstances of each insurer. Straightforward tests, with simple assumptions that cover the major risks, may be more useful than complex modelling that is difficult to understand or to validate. However, it would be expected that a prudent, well-managed insurer would regularly examine the quality and content of such tests, and seek to improve the methodology over time.

62. Risks are seldom totally independent or totally related. The insurer should examine the correlations among various risks to assess the effects they may have on the stress testing models and assumptions used. It is important that the extent of correlation that is assumed to apply in the future is not understated. There is evidence that in adverse situations, previously low levels of correlation can increase. Determining interdependency requires judgment, as there may be no historical data that throws meaningful light on new social and economic conditions.

63. The correlation and the interdependency among risks should be regularly evaluated. While the frequency of such evaluation should normally be fixed in advance, it may need to be done more frequently in times of crisis.

64. The correlation analyses are required to ensure that the interrelationship of risks is taken into account. For example, if an insurer was affected by a major catastrophe, other parties on which it is dependent may also have been affected, such as:

- reinsurers on which the insurer is reliant to meet claims
- intermediaries who generate future business

- other service providers, who may be unable to meet their contractual obligations or provide a full service
- counterparties in the capital markets (e.g., after the 11 September 2001 terrorist attack).

65. One stress may lead to another (e.g., cause and effect chains) and thus one may have to look at multiple risks. There are normally consequent effects, often in less-measurable risks, which should be taken into account when determining scenarios. An example is a regulatory requirement to augment, rather than just replenish, capital depleted by the stress conditions. These interactions may not occur immediately, but may evolve over time.

66. Determining the extent of dependencies that exist can be complex. A degree of prudence and pragmatism will be required when making judgment. This is particularly the case when determining tail-dependencies.

67. An example of tail-dependency would be where there are two risks that are usually uncorrelated, but where an extreme event for one risk may lead to greater loss from the other risk than would ordinarily have occurred. For example, a major catastrophe may coincide with a stock market collapse. The effects of the latter may be greater than expected due to investor nervousness. The 11 September 2001 terrorist attack is an example of this, since ordinarily an airline catastrophe would not accentuate a stock market decline.

10. Modelling management actions

68. Stress testing should generally consider the extent and effectiveness of options available to management in reacting to emerging risks. It is possible for a stress test to show a possibility of failure if no management action is assumed, but then be able to demonstrate that, with appropriate and timely management action, it is possible for an insurer to maintain a satisfactory financial condition.

69. There are many areas within an insurer's business that do not lend themselves easily to quantitative modelling, especially those that depend on the competence of, and actions taken by, an insurer's board and management.

70. The role of senior management is to develop and implement risk management policies, procedures and practices that translate the board's goals, objectives and risk limits into prudent operating standards. However, determining whether this role will be properly fulfilled requires judgment when performing stress testing.

71. Also difficult to quantify are:

- whether management decisions or actions are based on sound and prudent information or analysis
- issues surrounding staff recruitment and development
- whether too much reliance is being placed upon key persons.

72. Such considerations should form part of an insurer's overall risk management policies and procedures and, where possible, realistic estimates should be made of how quickly and how effectively the insurer will react to change. The speed assumed in modelling corrective action should be

consistent with the management culture, past experience and the existence of robust procedures for the identification of risk events so that management is able to respond in a timely manner.

73. When incorporating management actions into the stress testing, the following procedures should be followed:

- the impact of the stress event should be quantified and reported, without incorporating any management actions
- careful consideration should be given to the time it would take for management to recognise and respond to the problems, given the terms and conditions of policies and practices to be adjusted, and the extent and effectiveness of options open to management to act in response to the stress event
- the type and timing of the management actions should be incorporated in the stress test projection, and then be quantified and reported.

11. Limitations of stress tests

74. As a concept, stress testing is relatively straightforward. However, the application of this technique in practice is more complicated. Some of the difficulties are:

- determining what risk factors to stress
- establishing how such factors should be stressed
- establishing what range of values should be used
- determining the time horizon that such tests should consider
- meaningfully analysing the results and making informed judgments.

75. Another factor that insurers need to consider is that stress tests usually require good information systems and compatibility across business units, to properly analyse the interrelationships of risks. Internal communication flows among an insurer's business units are therefore important, particularly if there is not a dedicated resource area to undertake stress tests.

76. The extent to which parameters and variables are reliable should be reflected in the interpretation of results and resulting recommendations.

77. Reviews should occur regularly to ensure that they remain relevant to the changing risk profile of the insurer and external market conditions.

12. Reporting to board and management

78. A written report should be prepared that summarises the stress testing performed. This report should contain the following information:

- a description of the stress testing methodology and the key assumptions used in the stress testing models
- the results of the base case, e.g., using the same assumptions as the insurer's business plan
- the assumptions used in the stress testing scenarios and the interactions built into the models
- the results of the stress testing, before any management actions
- the extent to which data limitations affect the conclusions of the analysis
- the nature and timing of any management actions assumed in the models to mitigate the results of the adverse stress testing scenarios
- the results of the stress testing, including management actions.

79. An interpretive report is more desirable than a purely statistical report. In addition to a written report, an oral presentation that permits questions and discussions is desirable.

80. It is essential that the assumptions and results be presented in a manner that can be understood by an insurer's board and management and acted upon.

81. A report to the board and management should be prepared at least annually, unless stress testing is being performed less frequently (see Section 6).

82. The timing of the report may depend on the urgency of the matters reported and on the desirability of integrating stress testing into the insurer's financial planning cycle.

83. In some cases, a change in the insurer's circumstances since the last regular stress testing investigation may be so significant that to delay further testing and reporting to the time of the next regular report would be imprudent. In such a case, stress testing should be undertaken, and results reported, on an interim basis.

13. Public disclosure issues

84. This paper is not intended to provide guidance on public disclosure, but it gives some considerations regarding the decision by the supervisors in each jurisdiction on the level and form of public disclosure.

85. The existence of stress testing could form part of the information conveyed to external stakeholders who would have an interest in the level and quality of corporate governance within the insurer. Public disclosure of the broad outline of the nature of the tests that have been undertaken and how their results are used would allow stakeholders to understand the risk management capabilities of the insurer and to assess its underlying governance, policies, practices and systems.

86. If public disclosure goes further by disclosing the actual financial results of the stress test scenarios, various external stakeholders, such as insurance brokers, creditors, rating agencies, shareholders and policyholders could use this information to assist in their assessment of an insurer's ability to withstand adversity. Specifically, they could consider the effects such stresses would have

on the insurer's ability to meet policyholder liabilities and other obligations, and its future solvency position more generally.

87. It should be considered, however, that stress testing is a key risk management tool to help insurers to understand the consequences of extremely adverse situations. Stress testing might not achieve this key objective if insurers were required to publicly disclose the actual test results. Public disclosure requirements could discourage insurers from testing truly adverse scenarios. In addition, full disclosure may expose insurers to predatory actions by competitors and counterparties.

88. In deciding on what level and form of public disclosure of stress testing will be required, the supervisor should consider the possibility of misinterpretation of results, which may impact public confidence.

14. Use of the results by supervisors

89. The availability of stress testing information to the supervisor will enhance prudent supervision. On a routine basis, the supervisor should receive the results of the most material stress tests and the critical assumptions underlying them. The supervisor should also have access to full details on the assumptions and methodology used by the insurer in its stress testing. This will give the supervisor greater insight into the internal controls and specific risk management practices used by the insurer to manage its various risks.

90. When a supervisor prescribes standard tests, this assists the supervisor in benchmarking and comparative analyses. It may also enable the supervisor to quickly identify which insurers are likely to be affected by a major risk event, such as a natural disaster or the failure of a major reinsurer.

91. Where the stress testing results indicate an unsatisfactory prudential outcome, the supervisor should assess the insurer's response. If necessary, the supervisor may require the insurer to increase its capital, strengthen its systems and controls, or amend its business plan and strategies. The supervisor may also require the insurer to perform additional stress testing, to provide both the insurer and the supervisor with a more complete understanding of the situation.

92. The supervisor should be in a position to recognise which models have been useful in the past in the recognition and management of risks for insurers. However, the supervisor should generally not specify the use of a particular model for a particular insurer. The choice of the model and its appropriate use should be the responsibility of the insurer.

93. It would be appropriate for the supervisor to establish the requirements for stress testing for prudent risk management purposes for the insurer, e.g., the nature and minimum frequency of such tests. Some jurisdictions, in addition to requiring stress testing, may also prescribe broad minima for the factors that the testing must address.