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Educational Note

Dynamic Capital Adequacy Testing

Document 207108

Seeing Beyond Risk Canadian Institute of Actuaries Institut canadien des actuaires Voir au-delà du risque

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Committee on Risk Management and Capital Requirements

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Members should be familiar with educational notes. Educational notes describe but do not recommend practice in illustrative situations. They do not constitute Standards of Practice and are, therefore, not binding. They are, however, intended to illustrate the application (but not necessarily the only application) of the Standards of Practice, so there should be no conflict between them. They are intended to assist actuaries in applying Standards of Practice in respect of specific matters. Responsibility for the manner of application of Standards of Practice in specific circumstances remains that of the members in the Life and P&C practice areas.

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Memorandum

To: All Members in the Life and P&C Practice Areas

From: Jacques Tremblay, Chairperson
Practice Council

Denise Lang, Chairperson
Committee on Risk Management and Capital Requirements

Date: November 22, 2007

Subject: **Educational Note – Dynamic Capital Adequacy Testing**

The Canadian Institute of Actuaries published the last Educational Note on Dynamic Capital Adequacy Testing (DCAT) in June 1999. Draft changes to the DCAT Educational Note were released to members on April 11, 2007, with a comment deadline of June 1, 2007.

A number of suggestions and comments on the draft were received, which have been reflected in this final educational note. An overview of the changes is as follows:

a) Some changes were made to the paragraphs addressing potential regulatory actions under Ripple Effects, to give examples of when it may be appropriate to model regulatory action, and when it may be acceptable to not explicitly model regulatory action;

b) A few areas were changed where wording was not consistent between the Life and P&C sections;

c) A number of occurrences of "loss" were changed to "claim" so that "claim" is used throughout the note; and

d) Revisions were made to provide for greater clarity in a few areas.

In accordance with the Institute's Policy on Due Process for the Approval of Guidance Material Other than Standards of Practice, this educational note has been prepared by the Committee on Risk Management and Capital Requirements with the valuable contribution of the Committee on Property and Casualty Insurance Financial Reporting, and has received final approval for distribution, from the Practice Council, on November 21, 2007.

If you have any questions or comments regarding this educational note, please contact Denise Lang at her CIA Online Directory address.

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1. INTRODUCTION

The primary purpose of this document is to provide guidance and support to actuaries of Life and Property and Casualty (P&C) insurers in performing Dynamic Capital Adequacy Testing (DCAT) analyses in accordance with the CIA's Standards of Practice – Practice Specific Standards for Insurers, Section 2500, Dynamic Capital Adequacy Testing. It replaces the June 1999 educational note on Dynamic Capital Adequacy Testing – Life and Property and Casualty.

According to subsection 2520 of the Standards of Practice:

.01 *The actuary should make an annual investigation of the insurer's recent and current financial position, and financial condition, as revealed by dynamic capital adequacy testing for various scenarios.*

.02 *The actuary should make a report of each investigation in writing to the insurer's Board of Directors (or to their audit committee if they so delegate) or Chief Agent for Canada. The report should identify possible actions for dealing with any threats to satisfactory financial condition that the investigation reveals.*

.03 *The actuary should also make an interim investigation if there is a material adverse change in the insurer's circumstances.* [Effective January 1, 2003]

DCAT is a process of analyzing and projecting the trends of an insurer's capital position given its current circumstances, its recent past, and its intended business plan under a variety of future scenarios. It allows the actuary to inform the insurer's management about the implications that the business plan has on capital and to provide guidance on the significant risks to which the insurer will be exposed.

DCAT has the following key elements:

- development of a base scenario;
- analysis of the impact of adverse scenarios;
- identification and analysis of the effectiveness of various strategies to mitigate risks;
- a report on the results of the analysis and recommendations to the insurer's management and the Board of Directors or Chief Agent; and
- an opinion signed by the actuary and included in the report on the financial condition of the insurer.

The principal goal of this process is the identification of possible threats to the financial condition of the insurer and appropriate risk management or corrective actions to address those threats. The process arms the insurer with useful information on the course of events that may lead to capital depletion, and the relative effectiveness of alternative corrective actions, if necessary. Furthermore, knowing the sources of threat, it may be advisable to strengthen the monitoring systems where the insurer is most vulnerable.

The subsequent sections of this document cover the following:

Method: This section provides guidance on the DCAT process, forecast period and approaches to developing the base scenario and adverse scenarios, including ripple effects and integrated scenarios.

Modeling: This section identifies key elements to be considered in building a DCAT model used to project the financial results under the base scenario and the adverse scenarios.

Reporting: This section provides guidance on the key elements to be considered in reporting the results of DCAT, along with an outline of a typical report.

Appendices: Discussion and Analysis of Life Insurer Risk Categories

Discussion and Analysis of Property and Casualty Insurer Risk Categories

2. METHOD

Process

As described in subsection 2530 of the Standards of Practice, the DCAT process is to include:

- reviewing the recent and current financial position of the insurer;
- running a base scenario and several adverse scenarios; and
- reporting the results of the analysis including details on at least three adverse scenarios.

It is fundamental to this process and to the proper interpretation of the results, to understand that the projected capital position under various scenarios may well become inadequate during the forecast period, especially if the insurer's actions have not been assumed to be implemented on a timely basis as results emerge. This is not in itself an indication of current or anticipated difficulties. It is the specific degree and timing of capital depletion that indicate the risks to which the insurer is particularly sensitive. This, together with the results under the base scenario, would guide the insurer as to the necessity of revising the business plan, or preparing for contingencies.

To perform the DCAT, it is necessary to have an understanding of minimum regulatory capital requirements. It is recommended that the actuary verify the current regulatory requirements for his or her own company's situation.

Appendices A and B to this educational note provide additional details on the risk categories to be considered in developing the adverse scenarios. The risk areas posing most significant threats would be examined in detail, including ripple effects.

Considering the role of the actuary as defined in the Standards of Practice, the process to be followed in carrying out this analysis would generally be similar from one insurer to another with some degree of uniformity in the standard of plausibility of scenarios and approaches taken towards testing.

Approach

A typical approach would include the following steps:

- review of operations for the recent years (normally at least three years) and of the financial position at the end of each of them;
- development and modeling of the base scenario for the forecast period – as stated in the Standards of Practice, this would normally, but not always, be consistent with the insurer's business plan;
- assessment of the risk categories and identification of those that are relevant to the insurer's circumstances. Some risk categories may not be relevant and would need no analysis whatsoever. Sensitivity testing may be used to determine the relevant risk categories for the company;
- selection of plausible adverse scenarios requiring further analysis from the relevant risk categories:
    - development and modeling of the plausible adverse scenarios that are likely to significantly impact surplus or that may cause the insurer to fall below the minimum regulatory capital during the forecast period. The scenarios may be single-risk scenarios or integrated scenarios resulting from a combination of single-risk scenarios. Sensitivity testing may be used to determine the adverse scenarios;
    - identification and modeling of associated ripple effects caused by a change in assumptions triggered by an adverse scenario;
    - consideration of stress testing the adverse scenarios. Stress testing means a determination of just how far the risk factor(s) in question has to be changed in order to drive the insurer's surplus negative during the forecast period, and then evaluating if that degree of change is plausible. Depending on the insurer's circumstances, the Board or Chief Agent and management may also be interested in situations that cross other break points, in which case further stress testing may be beneficial.
- selection of at least three scenarios, from those modeled, showing the greatest surplus sensitivity for inclusion in the DCAT report. Any modeled scenario that causes the insurer to fall below the minimum regulatory capital during the forecast period would be subject to reporting;
- identification of possible management actions and the impact of these on the insurer's financial condition for each scenario included in the report;
- identification of possible regulatory actions for each scenario that causes the insurer to fall below the minimum regulatory capital level. For best practices purposes, it would be preferable also to identify possible regulatory actions that may be triggered as a result of falling below any other thresholds set by regulator(s).

The regulator might ask for other DCAT analyses to be conducted, including additional adverse scenarios and longer forecast periods.

Recent and Current Financial Position

Paragraph 2530.01 of the Standards of Practice states,

> The investigation would review operations of recent years (normally at least three years) and the financial position at the end of each of those years.

The review would include the statement of income and source of earnings (if available) for each year and the financial position at the end of each year including the balance sheet and the results of the applicable regulatory tests of capital adequacy. The actuary would analyze recent trends in these statements and would investigate the circumstances and key factors contributing to those trends. It is important for the actuary to be aware of the reasons underlying any such recent trends.

Forecast Period

Paragraph 2530.07 of the Standards of Practice states,

> The forecast period begins at the most recent available fiscal year-end balance sheet date. The forecast period for a scenario would be long enough to capture the effect of its adversity and the ability of management to react. The forecast period for a typical life insurer would be five fiscal years. The forecast period for a typical property and casualty insurer would be three fiscal years.

The first year of the forecast period is sometimes called the "stub" year. It is the current year that immediately follows the starting balance sheet date. The adverse scenarios typically would occur in the second and subsequent years.

As stated in the Standards of Practice, for some adverse scenarios, it may be necessary to use a longer forecast period than the typical one suggested therein, in order to measure properly the full effect, including the ripple effects, of an adverse scenario on the financial condition of an insurer.

Materiality Standard

The standard of materiality would usually be less rigorous than that used for valuation of the insurer's policy liabilities and, if practical, the actuary would discuss it with the insurer's management. In selecting a materiality standard, the actuary would also give consideration to:

- the size of the company;
- the financial position of the company. The standard of materiality would become more rigorous in examining a base scenario where capital adequacy is closer to the minimum regulatory requirement;
- the nature of the regulatory test. For example, if the regulatory test is measuring required capital, the materiality standard might be expressed as a percentage of the required capital.

For more guidance on materiality, refer to paragraph 1340.04 of the Standards of Practice.

Base Scenario

According to paragraph 2530.09 of the Standards of Practice,

> the base scenario is a realistic set of assumptions used to forecast the insurer's financial position over the forecast period. Normally, the base scenario is consistent with the insurer's business plan. It is awkward if the base scenario is not consistent with the business plan, because it implies a difference in outlook between the insurer's management and the actuary. The actuary would normally accept the business plan's assumptions for use in the base scenario unless these assumptions are so inconsistent and unrealistic the resulting report would be misleading. The actuary would report any material inconsistency between the base scenario and the business plan.

The above standard does not necessarily imply that the projected financial results and future financial positions would be identical to the projections prepared at the time the insurer's business plan was approved. Typically, there is a difference between the timing of the starting balance sheet date for the DCAT analysis and the timing when the business plan was approved. During this time, events may have occurred that lead to definitive changes in assumptions including any ripple effects. The projection of the future financial condition would reflect any material change that has occurred during this time particularly if the DCAT analysis is done later in the year. Another possibility is that differences in opinion have emerged that lead to different base scenario assumptions from those in the business plan. The report would differentiate between factual changes and subjective changes between the base scenario and the business plan.

The projected financial results and future financial positions under the base scenario may continue to be consistent with the business plan while still recognizing:

- for distribution assumptions that differ from those expected in the business plan;
- recent management decisions that may have not been anticipated or discussed in the business plan;
- changes in the capitalization of the insurer not expected in the business plan;
- the impact on future experience, where appropriate, due to actual recent experience, assumptions or decisions as described above.

It is expected that significant deviations from assumptions in the business plan approved by the directors, as well as significant deviations in the results for the forecast period, would be documented in the report. Where differences in the base scenario are not due to a recent reforecast of the business plan, the actuary would run the business plan as an additional scenario to ascertain the deviations in the results and would explain the rationale for the changes.

There will be some situations where capital injections are a basic part of an insurer's business plan. A simple example is when the business plan calls for an insurer to grow quickly with capital injections to support this growth. Another example is the case of an insurer that is intending a major initiative in a new sphere of operations, and is intending to raise capital externally in support of that venture.

The actuary would still be able to sign the usual DCAT opinion, even though the business plan and the DCAT base scenario call for capital injections, if the actuary is satisfied that any such capital injections are the intent of the entity making the injection, and has no reason to believe that such injections are not within the means of that entity. In order to

avoid presenting misleading results, clear reporting of assumptions made regarding capital injections is essential.

Plausible Adverse Scenarios

According to paragraphs 2530.10 and 2530.11 of the Standards of Practice:

> A plausible adverse scenario is a scenario of adverse, but plausible, assumptions about matters to which the insurer's financial condition is sensitive. Plausible adverse scenarios vary among insurers and may vary over time for a particular insurer.
>
> and
>
> The actuary would consider plausible material risks to the insurer. Scenario testing may be required for the actuary to determine the sensitivity of the insurer's capital adequacy to each risk.

Appendices A and B list and describe in detail the most common risk categories for Life and P&C insurers, respectively. Paragraphs 2530.12 and 2530.13 of the Standards of Practice state that the actuary would test threats to capital adequacy under plausible adverse scenarios that include, but are not limited to, the risk categories that are listed in the appendices. The actuary would consider whether the circumstances of the insurer result in the need to examine other risk categories.

For relevant risk categories, the actuary would select one or more plausible adverse scenarios to be modeled. When stochastic models with reasonable predictability are available, an adverse scenario would be considered plausible if it reflects the 95th to 99th percentile of outcomes. Generally, a 95th percentile or greater result would be required for a scenario to be deemed adverse, but less than or equal to a 99th percentile for the scenario to be deemed plausible. However, in some circumstances the actuary may feel it is appropriate to examine higher percentile outcomes. For risks where no stochastic models with predictive capabilities are available, the actuary would consider the variability in historical results and credibility of data, among other things, in selecting plausible adverse scenarios. It is expected that each of the adverse scenarios selected would be in the range of a 95th to 99th percentile outcome.

An alternative approach for selecting adverse scenarios is stress testing. This involves, first, determining how far the risk factor(s) in question has to be changed in order to drive the insurer's surplus negative during the forecast period, and then evaluating whether that degree of change is plausible. Likewise, the actuary may adjust the level of the risk factor to get a scenario result that is in the 95th to 99 th percentile range. Depending on the insurer's circumstances, the Board or Chief Agent and management may also be interested in scenarios that cross other break points, in which case further stress testing may be beneficial.

Any differences between the business plan and the base scenario would, typically, also affect all adverse scenarios. The adverse scenarios would build on the assumptions and actual experience that is already reflected in the base scenario, particularly if the base scenario already reflects some adverse conditions that have been experienced during the first part of the year. If the base scenario does not reflect adverse experience already seen (because this is projected to improve in the future), the adverse scenarios would not be more favourable than the actual adverse impact already experienced by the insurer.

The actuary would select three or more adverse scenarios from those modeled, showing the greatest surplus sensitivity to be examined in further detail, including more detailed reflection of the associated ripple effects. Any modeled scenario that causes the insurer to fall below the minimum regulatory capital during the forecast period would be subject to further examination and reporting. Depending on insurer circumstances, it may be beneficial to also examine any adverse scenario, from those modeled, that puts the insurer very close to the minimum regulatory capital level. Again, the stress testing approach, but now taking fuller account of ripple effects, may be used to assess sensitivity.

It is expected that the actuary would report on the considerations for determining the adverse scenarios. It is expected that adverse scenarios posing the greatest threat to the financial condition would be discussed in more detail, including ripple effects and assumed management actions.

The prerequisite for a satisfactory opinion is that the insurer will be able to meet its future obligations under all plausible adverse scenarios. The insurer's future obligations are met if it remains solvent at all projected dates. For testing most adverse scenarios, it would be appropriate to assume no additional capital arises from outside sources, beyond that called for in the business plan and base scenario. In adverse scenarios where the "adverse" factors are more under management's control (such as a scenario of much higher sales than planned), capital injections beyond those anticipated in the base scenario, or other management actions, may be appropriate. It may also be appropriate to assume decreases in future projected capital distributions.

In order to avoid presenting a misleading result, clear reporting of assumptions is essential whenever there are additional injections, or decreases in capital distributions, that are deemed appropriate under an adverse scenario. In such adverse scenarios, reporting of DCAT results with and without the assumed additional injections is recommended.

Similarly to the situation with capital injections or distributions, there will be some situations where management action in response to adverse scenarios would be assumed to occur. An example would be deteriorating mortality or morbidity experience on group insurance written on a one-year term renewable basis, or generally deteriorating loss ratios in certain lines of P&C insurance. This is not to say that all the adversity in poor claims would be assumed away through rate increases, but to assume no management action whatsoever in the form of premium rate increases, tightening up of underwriting, modification of benefit definitions, etc., would appear implausible (this is clearly different from long-term individual life insurance policies with fully guaranteed rates and provisions).

In order to avoid presenting a misleading result, clear reporting of assumed management action is essential and for each of the modeled adverse scenarios posing the greatest risk, the actuary would report the results with and without the effect of extraordinary management action.

Ripple Effects

Whenever an adverse scenario is modeled, it is common to consider associated ripple effects. A ripple effect is an event or incident that occurs when an adverse scenario

triggers a change in one or more interdependent assumptions or risk factors. Ripple effects include:

- adjustments to assumptions used in the base scenario which may no longer be appropriate in the adverse scenario being tested;
- the insurer's expected response to adversity;
- policyholder actions;
- regulatory actions, especially under any adverse scenario where the insurer fails to meet the minimum regulatory capital requirement;
- rating agency actions, especially in adverse scenarios that result in significant changes in capital or surplus; and
- likelihood of changes in planned capital injections or distributions.

For the more sensitive adverse scenarios, the results with and without the effect of any extraordinary management actions would be reported. An example of extraordinary management action would be discontinuing the sale of a line of business where such discontinuance is not part of the business plan. On the other hand, changing a dividend scale or increasing property and casualty rate levels would not normally be considered to be extraordinary management actions. The actuary would describe the expected management response, so that the users may consider its practicality and adequacy.

The actuary would inform management and report on potential regulatory actions and repercussions and would consider when it may be appropriate to model or calculate the financial impact of such actions. The financial impact of regulatory actions could be significant (particularly in situations where the insurer's ability to write new business is affected) and the Board or Chief Agent may be particularly interested in seeing the modeled impact in the DCAT analysis. The actuary would consider actions that could be taken by the Canadian regulator(s) as well as by regulators in foreign jurisdictions. Such regulatory action and associated management response would consider the local assessment of solvency, regardless of the insurer's worldwide solvency position as measured by Canadian regulatory standards.

If the impact of potential regulatory action has been modeled in a recent DCAT analysis, it may not be necessary to model the impact again in a current DCAT. This would be reasonable if the actuary believes the scenario results have not changed materially and the regulator response and impact would be consistent with the earlier work.

Similarly, the actuary would inform management and report on potential rating agency actions and possible repercussions but would not necessarily attempt to model or calculate the financial impact of such actions, unless the actuary thought it would be necessary or useful as mentioned above for potential regulatory actions and repercussions.

Integrated Scenarios

An integrated scenario is a type of adverse scenario that results when two or more adverse scenarios are combined. The integrated scenarios could be a combination of low probability scenarios, or low probability scenarios combined with a higher probability adverse scenario. The adverse scenarios to be combined may be based on correlated or uncorrelated risk factors but the resulting integrated scenario would be realistic and

plausible with probability consistent with the 95th to 99th percentile range of the single-risk adverse scenarios selected. Stress testing may also be used to assess the plausibility of the integrated scenario. It is expected that integrated scenarios would also be examined including any associated ripple effects.

3. MODELING

Modeling normally is required to test the capital adequacy of the insurer under the base scenario and adverse scenarios.

Basic Requirements of the Model

Typically, the model reproduces key elements and pages from the financial statements, such as:

- balance sheet;
  - assets (investments, reinsurance recoverables where appropriate and other assets),
  - liabilities (policy liabilities, other liabilities, debt),
  - retained earnings/surplus.
- income statement;
  - revenues/premium income,
  - policy benefits/claims,
  - expenses,
  - income taxes,
  - preferred share dividends,
  - investment income.
- applicable regulatory measure of capital adequacy.

The model is expected to be valid on an accounting basis. The actuary would verify the validity of the model, specifically that:

statement of income = cash flows + change in balance sheet items[1]

Financial results would be consistent between the various parts of the model as well as from year to year. This would be true for major items such as invested assets, policy liabilities and surplus.

The insurer may use more than one model depending on the lines of business and jurisdictions. The modeling capability needs to be sufficiently flexible to enable the actuary to assess risks within each risk category. The model may be deterministic or stochastic or a combination of these.

[1] It is assumed that models will typically produce cash flows. It is possible that for some lines of business, alternative models are used (such as a trending approach, or Source of Earnings approach). In this case, the actuary would use an alternative validity check.

Model Validation in a Static Environment - Base Scenario

The validity of the model in a static environment is typically tested with the base scenario. Financial results would flow logically from one year to the next. Unless extraordinary changes are occurring in the insurance environment or in the business written by the company, it is expected that there would be continuity from the actual results of the most recent year to the first projected year and subsequent years. For example, it is expected that the following results would flow logically from year to year:

- cash and invested assets;
- policy liabilities;
- surplus;
- accounts payable;
- accounts receivable;
- deferred income tax amounts; and
- major cash flow items.

When building a new model, a possible approach to check the validity of the model is to use as input the data prior to the most recent actual year and use the experience of the last year to set the parameters. The result from the model would then be compared to the actual results. If the results between actual and projected are found to be sufficiently close, the model may be acceptable. The actuary would determine in advance acceptable differences in assets, liabilities, surplus, premium, investment income and net income.

When updating an existing model, a retrospective check on validity may be made. Each year after the actual results have been determined, differences between actual and base scenario model results would be justified.

Reasonableness in a Changing Environment – Adverse Scenarios

The model is expected to be reasonable for all scenarios. Evaluating the difference between the results of two scenarios is a good way to assess the ability of the model to quantify changes in key results under different sets of assumptions. The actuary is expected to verify that the magnitude and direction of change in key elements of the model is consistent with the change in assumptions.

Models constructed for purposes of capital adequacy testing will have to be run repeatedly under many different adverse scenarios. They would be flexible and allow for changes to be made to all underlying assumptions that form the various adverse scenarios.

Stochastic vs. Deterministic Approach

The approach used to determine adverse scenarios may be stochastic, deterministic or a combination of the two.

- Stochastic: Certain risks are ideally modeled stochastically, such as those related to capital markets and those where the statistical loss distribution may be inferred and percentiles for results readily determined.

- Deterministic: The adverse scenarios are selected judgementally by the actuary, based on considerations such as variability in historical results or credibility of data.
- Combination: Certain risks may be modeled stochastically and the results then used to derive a deterministic scenario that reproduces the desired stochastic results. The deterministic scenario would then be used as the adverse scenario for further analysis.

Examples of risks that are usually modeled stochastically include:

- Segregated fund – See Research Paper, "Use of Stochastic Techniques to Value Actuarial Liabilities under Canadian GAAP" (August 2001); and
- Exposure to catastrophe estimated from catastrophe modeling software.

Modeling of Ripple Effects

The model is expected to allow for the quantification of ripple effects of adverse scenarios. There are two possible approaches to generate the ripple effects; they could be:

- automatically generated by the model; or
- manually created by the actuary by modifying the appropriate assumptions.

For example, for a P&C insurer, the model could be built such that reinsurance rates will automatically increase in the year following a catastrophe – alternatively, the actuary may manually modify the relevant parameters. For a life insurer, increases in new money interest rates may provide an incentive for some policyholders to lapse products that do not adjust, or slowly adjust, policy elements to changes in interest rates. The change in lapse rate could be modeled automatically based on changes in interest rates or the actuary could make the adjustment manually.

Organizational Considerations

With the DCAT, the actuary is expected to make an investigation of the insurer's financial condition. Although the modeling may be done by line of business, business unit or geographical area, in order for the actuary to report on the financial condition of the insurer, for regulatory reporting, the model results would be aggregated at the legal entity level.

Some assumptions are normally established at a high level, as they would be applied throughout the model. The following are possible examples:

- economic parameters: interest rate levels, inflation, capital appreciation and unemployment levels; and
- demographic parameters: overall trend in mortality or morbidity for a life insurer.

It is expected that the assumptions underlying economic and demographic parameters be consistent within each scenario and between scenarios (unless being specifically tested by the scenario).

The DCAT model may be a powerful tool for risk management. In order to fulfill that function, it may be helpful to do the modeling at the levels where management decisions will be taken (e.g., business units, geographical areas, product lines). For life insurers, it may also be informative to examine changes to the sources of earnings associated with

adverse scenarios. It is desirable that the model has the ability to focus on a particular line of business, division of the company, fund, or territory. Since it is likely that models constructed for DCAT purposes will also be used for corporate planning, the model would be sufficiently flexible to reflect any reasonable changes in insurer operations that management may want to test. Of course, these same changes might very well be the subject of additional scenarios in the DCAT process.

The objective in designing the structure of the model is to facilitate the projection of the insurer's operations under a number of different scenarios. The insurer being modeled operates within an industry that is itself influenced by, and operates within, a geographic and economic environment. The insurer will have its own legal structure, and, within that, a management structure around which it will plan and monitor its financial results. In organizing the model, it is necessary to reflect this structure and determine where constraints apply and at which level within the hierarchical structure of the model parameters are best set.

In designing the structure for the model, the size and complexity of the organization will dominate. At a corporate level, capital infusions, shareholder dividend payments, income taxes, required surplus, investment of surplus, and corporate expenses, such as head office lease and overhead costs, have to be modeled. For a single product line company, these may be combined with the product projection.

In the more complex organization, while similar issues arise as in the single product line company, the need to segment the model arises. This may be driven by size, or certain products may be more efficiently modeled using different tools or techniques. Alternatively, there may be a desire to analyze specific units separately.

In order to derive model segments, the actuary may consider:

Management – This usually reflects the management structure. The business is subdivided into units and cost structures and management reports have been developed around them. Existing plans are assembled and decision-making centered on these units. These units will combine products and possibly investment units. Subsidiaries and foreign operations would fall into this category.

Product – This is usually the smallest subdivision of business considered. For life insurers, cash flow projections are usually already available, and the model may be built using these as the foundation. For P&C insurers, products with similar characteristics may be grouped together.

Investment – Usually investment segments are defined based on asset categories. Investment income allocation follows the investment structure. This method of subdivision would combine a number of similar assets for investment purposes.

It may be desirable to have further breakdowns within a segment to take into consideration different investment strategies or instruments that are exposed to distinctly different risks. These will require separate parameters, at the least, and may need different modeling techniques or valuation methods.

The interrelationship of insurance and investment cash flows feeding the asset model is critical. Cash available needs to be established before investment decisions can be implemented.

For P&C insurers, the modeling of investment may follow the insurer's investment strategy rather than be product specific.

It may be desirable that calculation of taxes and required surplus be done at a divisional level of the model on a stand-alone basis. However, when results are consolidated, these will have to be redone on a consolidated basis. This implies that such data, as necessary would be transferred to the corporate model to facilitate these calculations.

4. REPORTING

Reporting the results of DCAT is an integral component of the whole process. Significant time and effort are usually required to develop the capabilities to do the projection and analysis. The organization will not get rewards commensurate with this significant investment if the results of the analysis are not reported properly.

The primary purpose of the report is to communicate to the Board or Chief Agent and the insurer's management:

- the significant risks to which the insurer is exposed; and
- possible actions that could be taken to reduce or eliminate the exposure to those risks.

The audience for this report is, as noted in paragraphs 2540.01 and 2540.02 of the Standards of Practice, the Board of Directors (or their Audit Committee if they so delegate) or the Chief Agent of a Canadian branch of a foreign insurer, as well as the insurer's management and the regulator. These individuals have different backgrounds and qualifications. The actuary's challenge is to provide pertinent information in a comprehensible fashion to non-actuaries. The report would be in writing, but, as indicated in paragraph 2540.03 of the Standards of Practice, an additional oral report that permits questions and discussion is desirable. An interpretative report is more useful than a statistical report.

The actuary would prepare a single report that goes to the Board or Chief Agent. However, in some cases it may be useful to prepare an analysis for discussion with management that is more detailed and/or technical than the report prepared for presentation to the Board or Chief Agent. Nevertheless, it is not appropriate for the management analysis to present findings different than those contained in the report to the Board or Chief Agent.

Additionally, the Standards of Practice and the regulators require DCAT reports to include a signed opinion on the insurer's financial condition. Paragraph 2530.05 of the Standards of Practice states:

> The insurer's financial condition is satisfactory if throughout the forecast period it is able to meet all its future obligations under the base scenario and all plausible adverse scenarios, and under the base scenario it meets the minimum regulatory capital requirement.

An insurer is able to meet all its future obligations as long as its assets are greater than its liabilities.

The report need not include any commentary on the development and/or validity of the regulatory capital formula used. In most cases, it will suffice to disclose the following:

- the applicable federal and/or provincial regulatory formula(s);
- for insurers subject to minimum capital requirements under multiple jurisdictions, the rationale for using the selected formula; and
- the minimum requirement used in the projections and the rationale. The actuary may wish to refer to the insurer's primary regulator to identify the capital test and minimum regulatory capital requirements for the purposes of the DCAT standard.

It is recommended that the actuary verify the current regulatory requirements for the company's situation. It is further recommended that the actuary consult the regulator(s)' capital guidelines and rules as well as its supervisory guide to assess when and what type of intervention may be initiated if the financial condition of the insurer is not considered appropriate.

The report and any presentation would reflect what is important to the insurer's Board or Chief Agent. The following is an illustrative outline of possible elements of a comprehensive DCAT report.

1. Executive Summary

The executive summary is useful to provide a high level overview of the results of the DCAT analysis that is described in the report, including:

- summary of the results of the base and selected adverse scenario results;
- highlights of the most significant solvency risks and threats to satisfactory financial condition;
- review of the events since the previous DCAT report was submitted;
- commentary on management's action in response to the recommendations in the previous year's DCAT report, if appropriate;
- recommendations or advice for management to mitigate or eliminate risk; and
- other significant findings.

2. DCAT Opinion

The actuary would include a signed opinion on the future financial condition of the insurer. The opinion, as per paragraph 2550.03 of the Standards of Practice, would be adapted by the actuary to reflect the assumptions corresponding to the particular circumstances of the insurer.

3. Introduction

The introduction provides a forum to inform the user about the purpose and basis for the DCAT report, consisting of:

- description of the role of the Appointed Actuary;
- purpose and scope of the DCAT report; and
- overview of the processes and methods used for DCAT analysis.

4. Capital Adequacy Measurement

The actuary would explain the nature of the regulatory test used to measure the financial condition of the insurer, including:

- definition of minimum regulatory capital requirement;
- definition of satisfactory financial condition used in DCAT;
- definition of what constitutes a threat to satisfactory financial condition;
- description and summary of the insurers current solvency ratios; and
- materiality standard.

5. Background Discussion

This section of the report would provide an overview of the company, and the economic environment during the forecast period, including such things as:

- summary of the nature of the insurer's business, products and target markets;
- review of recent and current financial position;
- discussion of any key events or initiatives affecting the insurer in the recent past and any associated expected future developments;
- description of economic assumptions;
- discussion of the current and expected market condition; and
- discussion of prior year's DCAT results, recommendations and management actions, if appropriate.

6. Base Scenario

A clear description of the base scenario used in the DCAT analysis would include:

- brief description of the model or process used to project the base scenario;
- description of main assumptions, especially any capital injections or strategic initiatives;
- discussion of consistency of the base scenario with the insurer's business plan; and
- description of key financial results, including key income statement and balance sheet items, and capital test results. A desirable approach would be to display the results for each year in the projection.

7. Adverse Scenarios

This section of the report would provide detailed descriptions of the selected scenarios that pose the greatest risk to the insurer as well as any scenario, from those modeled, for which the insurer falls below the minimum capital requirement. An overview describing the process used to identify the scenarios would be useful. For each adverse scenario, the following items would be included where applicable:

- description of the risk being tested, key assumptions used including full descriptions of ripple effects, why the risk is significant to the insurer and how this was determined;
- comparison to prior year's DCAT, and consistency of the selected scenarios with the prior year's results (For example, if the scenarios have changed, this may be

because the risks facing the company have changed, because other scenarios are being constructed and tested, or for some other reasons.);

- description of stress testing results;
- description of key financial results and the change from the corresponding base scenario results, to allow the users of the report to fully appreciate the consequences of the various scenarios;
- description of any changes in the capital injections or distributions from those assumed in the base scenario, and results with and without these capital changes;
- results with and without extraordinary management action, if applicable, would be shown to aid the audience in appreciating the effectiveness of the risk mitigating strategy;
- discussion of possible regulatory actions and repercussions if the scenario results fall below the minimum capital level, in the absence of any change in the base scenario capital injections, capital distributions or other corrective management actions;
- discussion of possible reactions of rating agencies and repercussions, when applicable, if the insurer's capital is severely strained;
- discussion of changes in the adverse scenarios selected compared to the prior report's selection; and
- disclosure of other risk categories considered in undertaking the DCAT analysis, together with brief comments of why they were not selected for detailed analysis.

8. Conclusions and Recommendations

Overall conclusions from the DCAT analysis would be presented including a brief description and summary of the results of the base and selected adverse scenarios and highlights of the most significant risks to capital adequacy and threats to satisfactory financial condition. Any findings leading to follow-up actions would be discussed. It may also be appropriate, and consistent with best practices, to make one or more recommendations, particularly with respect to management actions that are intended to better manage or mitigate risk exposures.

9. Appendices

The primary purpose of the DCAT report is to inform the insurer's Board, or Chief Agent, and management of potential threats to future financial conditions and possible actions that may mitigate those threats, so a qualitative report is best to achieve this end. However, it would be desirable for the actuary to include some detailed financial results from the application of the DCAT model. Typically, the model creates key elements and pages from the financial statements, such as balance sheet, income statement and regulatory measure of capital adequacy. Copies of such exhibits for the base scenario and each of the selected adverse scenarios for the forecast period allow users to review the DCAT results in more detail.

APPENDIX A

DISCUSSION AND ANALYSIS OF LIFE INSURER RISK CATEGORIES

Paragraph 2530.10 of the Standards of Practice states,

> A plausible adverse scenario is a scenario of adverse, but plausible, assumptions about matters to which the insurer's financial condition is sensitive. Plausible adverse scenarios vary among insurers and may vary over time for a particular insurer.

The actuary is expected to develop an understanding of the sensitivity of the insurer's financial condition under each major risk category which is material to the company. Paragraph 2530.12 of the Standards of Practice states that "the actuary would consider threats to capital adequacy under plausible adverse scenarios that include but are not limited to" the risk categories listed. This Appendix outlines the major risk categories that would be considered in adverse scenario testing, and possible adverse trends and ripple effects for each. Each risk category section provides guidance about ripple effects (paragraph 2530.18 of the Standards of Practice), and possible management actions are listed where relevant. A ripple effect is an event or incident that occurs when an adverse scenario triggers a change in one or more interdependent assumptions or risk factors. For example, post-event epidemic mortality may follow a catastrophic event. A change in mortality unrelated to the catastrophe would not be considered a ripple effect, but would be considered under a separate risk category.

Adverse scenarios could include:

- gradual changes in experience which may or may not be detected for some time;
- shock changes to experience; and
- incorrect estimates of expected experience.

Recent industry and company historical experience and the outlook for the future could be considered in determining a range of possible future experience. The actuary may want to look at historical data such as CIA or other economic statistical data as a guide to help determine the possible deterioration of the risk.

The actuary may also consider systemic risk as a cause of some of the other risks. As an example, the failure or downgrading of one or more significant insurers in the market could result in marketing and/or reputational risk for the other insurers.

The actuary may also consider liquidity and operational risks, likely as ripple effects associated with other adverse scenarios.

Liquidity is the availability of funds, or assurance that funds will be available, to honour cash outflow commitments (both on- and off-balance sheet) as they fall due. Liquidity risk is the inability to meet financial commitments as they fall due, through ongoing cash flow or asset sales at fair market value. Under some adverse scenarios, cash flow results may fall outside the targets set in a liquidity risk management policy, in which case examining ripple effects and possible management responses may be beneficial.

The actuary may wish to consider operational risks, although the quantitative measurement of operational risk is still in its infancy and investigations may be more qualitative in nature. Systems and internal control procedures which may function well

under normal day-to-day operations may begin to break down under adverse scenarios developed as part of DCAT. As well, business continuity plans may not consider scenarios that are as adverse as those developed as part of the DCAT analysis. Other sources of information that may be useful in examining operational risk might be rating agencies (e.g., new product risk), and the Society of Actuaries.

If a life insurer writes P&C business and the P&C business represents a material risk for the company, the actuary would consider all risks covered in the P&C section of this educational note. If the P&C risk is not considered material by the actuary, the actuary would provide an explanation as to why it is not considered material. This is especially the case for some chartered life insurance companies operating in Québec.

Finally, the *Dynamic Financial Condition Analysis Handbook* of the Society of Actuaries is a good supplemental reference for risk areas and adverse scenarios that may be relevant for a given company, beyond those covered here.

1. Mortality Risk

Mortality risk can pose a significant risk to the capital adequacy of an insurer. Since annuity and insurance contracts tend to react very differently to adverse scenarios, the testing of those lines of business would be done separately.

For insurance business, adverse mortality may arise from a variety of causes, some of which include:

- an absolute increase in mortality rates, likely for a specific period of years and arising from an epidemic or other catastrophe;
- a steady and continued deterioration in mortality, arising from antiselective lapse experience as new and more competitive products are offered and also due to a weakening in underwriting standards;
- a steady and continued deterioration in mortality versus that assumed in valuation and/or new business pricing assumptions, which may include mortality improvement assumptions that are not fully realized;
- a misestimation of expected experience due to a lack of credible experience data; and
- for death-supported insurance policies, (i.e., policies where a decrease in mortality rates increases policies liabilities,) a steady and continued decrease in mortality rates, arising from changes in medical treatments and/or changes in policyholder lifestyles, at a different rate than assumed.

For annuity business, adverse mortality may arise from a variety of causes, some of which include:

- a steady and continued decrease in mortality rates, arising from improvement in medical treatments and/or changes in annuitant lifestyles, at a faster pace than that assumed; and
- a misestimation of expected experience due to a lack of complete experience data.

The actuary would consider whether such adverse mortality will be temporary or permanent in nature. Where appropriate, the impact would be reflected through a recalculation of reserves.

The actuary would consider possible ripple effects such as changes in sales levels and/or persistency following any pricing or benefit adjustments.

Possible management actions could include:

- for adjustable products, changing premiums and/or benefits (delay before management action, partial adjustment for the adverse mortality experience);
- adjusting the price of new business; and
- seeking reinsurance solutions.

2. Morbidity Risk

Adverse morbidity includes:

- increases in incidence rates for disability, medical, dental, critical illness, and other coverage; and
- decreases in the rate of claim termination.

These may arise from a variety of causes, some of which include:

- a prolonged high unemployment recessionary environment leading to both sharply increased incidence rates and low claim termination rates for disability;
- an increase in incidence rates without increasing death rates (for example, in the case of non-life threatening epidemic, or accident rates), or increased rates of diagnosis of critical illness as a result of sensitive diagnostic technologies;
- improved treatment for diseases, such as AIDS, that decrease both recovery rates and death rates for disabled lives and survival period rates for critical illness insurance;
- court rulings in favour of the policyholder which limit the insurer's ability to adjudicate claims;
- retrenchment of government social security programs;
- escalation in dental and medical costs; and
- misestimation of expected experience due to a lack of credible experience data.

The actuary would consider possible ripple effects such as:

- constraints to rate increases as the industry reacts slowly in implementing renewal rate increases;
- rate guarantees that limit or delay required rate increases;
- increases in antiselective lapses that may dampen – or nullify – the intended effect of rate increases; and
- adverse publicity/reputation damage arising from claim or underwriting practices associated with health/disability/sickness insurance, leading to decreased sales of new business.

Possible management action could include items such as:

- increasing rates; and
- more active claims management.

3. Persistency and Lapse Risk

Policy persistency can pose a significant risk to the capital adequacy of an insurer. Generally, persistency risk can be divided into two distinct categories:

- Whenever the cash value exceeds the reserve, the risk is that lapses or surrenders (hereinafter referred to as "lapses") will exceed those assumed in the valuation assumptions.
- Whenever the reserve exceeds the cash value, the risk is that lapses will be less than those assumed in the valuation assumptions. Such blocks of business are often referred to as "lapse supported."

In examining the persistency and lapse risks, it is prudent to assume that, because of antiselection, both these adversities may happen concurrently. Generally, the appropriate level of lapses would be assessed for each product line.

Causes of adverse persistency and lapse include:

- premium changes, including amount and payment pattern;
- dividend scale changes;
- changes in distribution system;
- a new product introduced to the market by a competitor;
- changes in underwriting and/or qualification criteria for preferred/select classes;
- changes in premium rates in the market;
- a sudden lack of confidence in the company which may be caused by a sudden downgrade by external rating agencies, combined with extensive publicity; and
- a misestimation of expected experience due to a lack of credible experience data.

Ripple effects for persistency and lapse risk could include:

- worsened mortality or morbidity, which may be caused by antiselection;
- mismatch of asset and liability cash flows;
- increased unit expenses;
- worsened liquidity risk (for example, a run-on-the-bank situation);
- reduction in company's new business while, at the same time, the company could not proportionately reduce its expenses;
- inability to borrow any external capital or debt and/or nonrenewal of existing borrowings at maturity; and
- changes in the expected mix of business.

4. Cash Flow Mismatch Risk (C-3 Risk)

Adverse scenarios related to C-3 risks could result from:

- mismatches between the cash flow pattern of assets and liabilities;
- variability in the cash flow pattern of assets and liabilities;
- changes in future rates of interest;
- market value deterioration in segregated fund assets; and
- assets and liabilities not in the same currency.

The actuary would test the impact of potential adverse scenarios on liabilities and surplus across all lines of business in aggregate. However, the potential management actions will depend on the nature and characteristics of the various blocks of assets and liabilities. Changes in future rates of interest will also impact the market value and earnings of surplus assets.

When there is a mismatch between the cash flow pattern of assets and liabilities, there will be a need to reinvest positive cash flows, and to borrow or liquidate assets to fund negative cash flows. Future rates of interest can vary substantially and can adversely affect surplus. As a result, the value of derivatives will also be impacted. Where they are used as hedges, they will help mitigate adverse impacts.

In assessing the impact of changes in interest rates, the actuary would consider both the current mismatch position as well as any possible mismatch in the future. This will depend on the maximum position allowed by the company's investment policy and the most aggressive position that has been taken in the past by the company.

Parallel and non-parallel shifts in the yield curve, both on a sudden and on a gradual basis, would be considered. Stochastic modeling as well as deterministic scenarios could be considered. In addition to specific scenarios, the actuary might also consider stress testing the C-3 risk by determining whether some future interest rate scenarios would result in the insolvency of the company. In practice, though, it can be difficult to determine under what interest rate scenarios insolvency actually occurs. Instead of stress testing, the actuary could examine additional deterministic scenarios, or more extreme tail results under stochastic modeling than is already reflected in the development of plausible adverse scenarios.

Changes in future interest rates will affect not only future rates of reinvestment and market values, but also the pattern of the cash flows. For example, this can occur with asset-backed securities, callable bonds and on policies with cash surrender values.

Future interest rates may also affect the spread that can be achieved on both new business and the fixed interest rate business where rate resets are being made.

Sustained low levels of interest rates could also affect the company's ability to support minimum long-term guarantees embedded in both insurance and annuity products.

Future interest rate levels will also affect the amount and mix of new business for guaranteed fund and segregated fund products. Likewise, interest rate levels will also affect the number of surrenders, transfers between funds and shifts between portfolio average and new money products. The movement and financial exposure will depend on surrender charges and market value adjustments embedded in these products. Particular consideration would be given to assessing the effect of a "run on the bank" scenario.

For participating insurance, universal life and adjustable premium business, considerations would include:

- the impact on the proportion of fixed income assets backing participating business and the duration of those assets, and that of key competitors;
- dividend actions of competitors;
- the ability and willingness of management to maintain or change dividend scales;

- reviewing premiums and charges of universal life products;
- related policyholder actions such as surrender levels and potential litigation; and
- the impact on the level of new sales.

For segregated funds, drops in market value may affect the payment of benefits (or the likelihood of future payment of benefits) relating to the existence of guarantees of minimum segregated fund performance. Considerations would include:

- the extent of minimum performance guarantees provided on death or maturity;
- the extent of hedging operations or reinsurance to mitigate the risk;
- the existence of product features such as resets which will affect the risk; and
- the existence of volatile funds, fund switching privileges, guarantees on a "per policy" basis or high MERs.

Possible management responses may reflect the effect of any dynamic hedging programs that are in place.

5. Deterioration of Asset Values (C-1 Risk)

In determining a plausible adverse scenario for this risk, the actuary may want to look at historical data such as the CIA's statistics to fit the deterioration of asset values. Adverse scenarios in respect of C-1 risk (deterioration of asset values) may arise from a variety of sources, including:

- increases in losses from defaults on debt securities;
- poor returns and/or declines in value of equities;
- poor returns and/or declines in value of real estate;
- counterparty defaults on derivatives;
- loss or significant decline of value for other major asset categories;
- concentration risks including geography (e.g., impact of natural disasters), asset class, industrial sector, subsidiaries, individuals;
- poor returns and/or declines in value of subsidiary; and
- fluctuations in currency values.

The actuary may consider an integrated scenario in which a combination of the following events occur:

- a drop in the market value of debt securities based on a hypothetic increase in the yield curve;
- a decline in equities caused by a significant drop in the S&P/TSX index or any other significant stocks index;
- a significant decline in the value of real estate, and
- a significant decline in the value of the largest subsidiary.

The actuary would consider how to reflect the effect of such events in determining policy liabilities and also consider expected pricing actions. The ripple effects could vary depending on whether the C-1 results are company-specific or industry wide.

The following are possible ripple effects:

- exposed risk positions as a result of counterparty default (example C-3 risk);
- a ratings downgrade of the insurer which could, in turn, lead to decreased sales and increased surrenders;
- liquidity issues or forced asset liquidation risk issues caused by large sustained credit related losses either through defaults or severe asset downgrades;
- counterparty defaults on derivatives;
- decreased policy owner dividends which could lead to higher surrenders; and
- increased disability claims frequency and severity due to deterioration of economic conditions.

Possible management actions may include:

- a shift in the investment strategy; and
- a review of premium rates.

6. New Business Risk

One of the uncertainties facing an insurance company is the volume of new business that it will be able to write in the future. Volumes significantly different from those assumed can result in a capital position quite different from that expected, with negative outcomes. It may be equally important to examine both higher than expected and lower than expected levels of new business production. Even in the case where total business volumes have been estimated accurately, new business risk may still be present if the mix of business sold is different from that expected. An example would be entry into a new line of business or product.

There are several events which could lead to a significant reduction in premium volume written by an insurance company, including:

- a financial rating downgrade of either the company itself or of an affiliated company (particularly the parent), or some other event similarly damaging to a company's reputation;
- entry of a new and strong competitor into an area where competition was previously weak and/or increased competitiveness in the market due to higher usage of advertising by competitors;
- loss of a key distributor or even an entire distribution channel previously responsible for the production of a significant portion of a company's business; and
- loss of a key client such as a large group client representing a significant portion of an insurance company's group portfolio.

The most significant impact of lower than expected sales would be that the insurer is not able to cover its expenses, particularly when there is a large element of overhead and fixed expenses associated with marketing, underwriting, policy issue and sales functions.

Ripple effects could include:

- higher lapse rates on existing business (which could be significant, depending upon the event causing the reduction in new business);

- poorer claims experience on the remaining business;
- poorer coverage of maintenance expenses (resulting from both lower current sales as well as higher lapses on existing business);
- possible ripple effects on other lines of business associated with the line of business that was initially affected (For example, distribution channels primarily involved in one line of business may contribute to significant future sales in another line.); and
- mix of business different from expected.

Possible management actions could include items such as:

- reviewing bonuses paid to agents and brokers;
- diversification into more than one line of business;
- control over non-variable expense levels; and
- maintaining contingency action plans to be implemented in case one of these events occurs.

When the company has written a greater amount of new business sales than expected, this could lead to severe capital strain for the company. Events that could lead to a significant increase in premium volumes written by an insurance company:

- unexpected success in a new product area or in beating previously stronger competition;
- exit of a competitor from a product or market;
- rate increase implemented by other companies leading to a "fire sale" for products still in the market at lower rates;
- tightening of product features by other companies in the market; and
- change in reinsurance arrangements leading to a higher than expected retention on new business.

Ripple effects could include:

- problems with management control over policy issue, underwriting, field expenses, financial reporting, etc., due to rapid growth (This could lead to future problems in claims and expenses as competition eventually catches up and volume levels return to normal.); and
- future expected lapses, mortality, or morbidity could be different if sales are driven by "old generation" products.

Possible management actions would include:

- putting capital-raising plans in place with a parent company or with external sources;
- contingency plans to be able to handle the increased volumes of business;
- reviewing rates and underwriting guidance;
- reviewing the use of reinsurance to mitigate the need for additional capital; and
- withdrawing a product or a line of business.

Normally, the base scenario would incorporate the new business projections of the company's business plan and associated expense levels. Alternate scenarios would be heavily company-dependent, varying in particular with the kind of market the company serves and the distribution channel employed to reach it. However, any alternate scenario would be expected to reflect not only the change in new business levels, but also the impact on expense coverage and any other possible ripple effects.

7. Expense Risk

Expense assumptions are a major consideration in the projected financial position of every insurer. These assumptions are unique in that, to some degree, company management has a greater level of influence on expenses than on other assumptions. Even insurers who, historically, have aggressively managed their expenses to budgeted targets may face major expense issues in some situations such as an unexpected variation in new business growth, litigation or other development. Companies practising strict management of budgets to meet expense levels included in pricing may have different results from companies that manage budgets to other measures. The extent to which the company has demonstrated effective actions towards managing expenses in the past would be a consideration in how closely to relate expense levels under adverse scenarios to expenses in the base scenario.

Adverse expense scenarios and related ripple effects to which an insurer's financial condition may be sensitive include:

- **Inflation** – A severe inflationary environment may cause a rapid increase in absolute expenses and in unit costs. A high inflation scenario would normally be assumed to accompany a high interest scenario, and the two would logically be linked. However, the actuary may also consider a scenario where high inflation is not accompanied by high interest rates.
- **Technological obsolescence** – New technologies may be developed which deliver significant cost, delivery, or service benefits for those who can achieve economies of scale. For companies that do not make use of new technologies, expenses may rise relative to the competition. Such a scenario would also include the sales and termination impacts of technological obsolescence.
- **Court awarded damages** – Potential high costs can result from court awarded damages to plaintiffs relating to such matters as market conduct. Ripple effects resulting include damaged industry reputation, ratings downgrades, lower sales and higher terminations.
- **Industry or guarantee fund assessments** – Further industry failures can precipitate higher assessments to companies in the industry. Ripple effects from such failures can include damaged industry reputation, flight to quality, lower sales and higher terminations in some instances.
- **Company structure** – Holding company expenses may be allocated to subsidiary companies based on historical or projected relative profits. This could lead to a major change in the level of expenses allocated to the insurer based on the performance of one of the other companies in the enterprise. Within a single insurer, methods of allocating overhead expenses to different business units may

produce changing expense levels over time. In an enterprise which has several insurance companies or business units that provide services to one another, the impact of cross-billing would be considered.

- **Mergers and acquisitions, or assumptions of new business** – Reductions in unit expenses after a merger, acquisition, or assumption of a new block of business may be delayed or lower than projected in the base scenario.

Possible ripple effects could include:

- changes in product pricing;
- low sales; and
- higher lapses.

8. Reinsurance Risks

Reinsurance risk arises from a reinsurer's failure to meet its obligations to the insurer, or from a change in market conditions causing an increase in rates, inadequate limits, or otherwise inadequate or unaffordable coverage. In this context, the term "reinsurer" is intended to include both reinsurers, if the company is a primary insurer, and retrocessionaires, if the company is itself a reinsurer.

Reinsurance terms on most individual life cessions tend to be guaranteed for the life of the underlying policy. The primary risks for a ceding company are outlined below.

- **Insolvency of a reinsurer**– The actuary would calculate the company's exposure in the case where its principal reinsurer(s) become(s) insolvent. This impact would reflect an assumed "realization percentage" of assets to liabilities of the failed reinsurer, and any different treatment of various types of amounts owing from the reinsurer to the direct writer. The impact of a reinsurer's insolvency may be mitigated by the following provisions:
    - the right of offset of amounts owing under all treaties between the two companies;
    - the preferred position insurers will have relative to other creditors of a failed reinsurer;
    - the right of recapture in the event of the reinsurer's failure; and
    - access to amounts on deposit or assets in trust with the insurance company, or letters of credit in respect of an unlicensed reinsurer.

  Under this scenario, it would normally be appropriate to assume that the business previously ceded to the insolvent reinsurer could be successfully reinsured elsewhere, but possibly on less favourable terms. However, there may be certain unique features regarding the business involved that would make securing such replacement of reinsurance difficult.

- **Increases in reinsurance rates on future new business** – Where a reinsurer takes market wide action impacting all of its insurers operating in similar markets, such action would not necessarily pose competitive issues, as these insurers would all be faced with an increase in reinsurance rates, possibly requiring repricing in a large segment of the marketplace. However, where a reinsurer's action is targeted

to one specific company because of poor experience, necessary repricing could affect the level of sales.

- **Reduction in reinsurance capacity available for the financing of new business** – This could result in an increase in reinsurance costs and/or constraints on the amount of new business growth of the company.
- **Disputes over policy conditions** – The actuary could consider a dispute over reinsurance policy conditions which results in a principal reinsurer denying coverage for a significant class of business or category of claims, for example, terrorism exclusions.

9. Government and Political Risk

When the government makes changes to its policies or regulations, the implementation of such changes usually takes a considerable amount of time. This provides a Company the time to analyze the impact and to take appropriate actions, if necessary. However, some changes can occur in a very short period of time and cannot be foreseen. There may also be cases where such changes are effective retroactively without any grandfathering provisions. In such cases, the adverse scenario may be modeled in the first year if the scenario is plausible in that time period.

The actuary would likely focus on changes that are being discussed or proposed by government entities. However, in some situations it may be beneficial to consider other changes, particularly for certain lines of business that have a greater sensitivity to political intervention, and if those lines of business are material to the insurer.

Examples of adverse events are:

- an increase in premium tax rates;
- an increase in taxation rates for corporations (income tax or capital gains tax);
- a prolongation of temporary taxes;
- new restrictions on RRSPs or RRIFs which would have a direct impact on the level of new business for those products;
- the possible entry of other financial institutions into the life insurance industry (e.g., due to revisions to the Bank Act) which would affect the amount of new business and could lower profit margins due to increased competition;
- possible new restrictions on the investment practices of life insurance companies (e.g., a restriction on the use of derivative products for speculation or hedging);
- the introduction of new or modified public health care policy which could decrease new sales or in-force business (e.g., the introduction of Pharmacare);
- a change in regulatory solvency standards which could increase the capital requirements for life insurers (e.g., the introduction of the lapse component to the capital requirements);
- a reduction in the government's need to borrow funds which could affect the level of government bonds available to the market;
- political instability which could lead to confiscation of assets, closure for new business, exchange controls, etc., particularly in foreign jurisdictions;

- impact of cost shifting between public and private sectors or changes in coverage under public insurance plans;
- a change in law or regulation directly affecting an important product line (e.g., a change in tax law affecting the position of the policyholder, a change in capital or reserving requirements putting a particular type of product at a competitive disadvantage relative to products provided by other financial institutions or even other insurance providers);
- a change in legislation that restricts the use of some distribution channels; and
- benefits, premiums or rate adjustments subject to regulation.

For a specific scenario, possible ripple effects may include:

- increased litigation costs;
- forced liquidation of assets due to cash flow strains;
- increased regulatory monitoring;
- increases in the policy liability; and
- increases in reinsurance rates and/or non-availability of reinsurance of new business.

10. Off-Balance-Sheet Risk

There are numerous off-balance-sheet items which may place an insurer at risk. Often these off-balance-sheet items arise from new or evolving industry practices which, in future years, do get recognized on the balance sheet by the CICA, the CIA or regulators. Therefore, the actuary needs to be aware of any emerging risks that may be relevant to the insurer during the forecast period and assess their potential threat to the company's solvency.

Discussed below are examples of common off-balance-sheet items and their related risks that may be relevant to the insurer:

- **Operating lease obligations** – The lessor is exposed to credit risk associated with the lessee's inability to meet its lease obligations.
- **Derivative instruments** – The risks associated with derivatives include market risk, default risk, management risk and legal risk:
    - Market risk includes marketability risk and basis risk. The marketability risk is the risk of not being able to cancel or unwind one's contract when desired or at a favourable price. Basis risk is the risk that the derivative's price behaviour does not act as expected, undoing the intended hedging benefits. The price behaviour of the instruments can change adversely when market conditions change. Market risk is best evaluated on a security basis and on a portfolio basis since some risks may not net against each other.
    - Default (or credit) risk is the risk that a loss will be incurred due to a default in making the full payments when due, in accordance with the terms of the contract.

  - Management risk is the potential for incurring material, unexpected losses on derivatives due to inadequate management supervision and understanding, systems, controls, procedures, accounting and reporting.
  - Legal risk is the risk that the derivative agreement is not binding as intended.
- **Contingent liabilities or losses** – There are a variety of contingent liabilities to which a company may be exposed, such as tax, litigation, etc. The actuary would consider the financial impact of adverse outcomes.
- **Letters of credit and pledged assets** – The insurer may be exposed to the risk that a lending institution defaults on payment under, for example, a letter of credit, or there is a call on assets pledged.
- **Capital maintenance agreements** – An insurer could be exposed to capital maintenance agreements it must honour for its subsidiaries (e.g., if an insurer has to guarantee a certain capital level in a subsidiary).
- **Employee and senior management benefits and liabilities not listed on the balance sheet (e.g., pension plans, stock option plans)** – This carries the risk of increasing costs.

11. Related Company Risk

The related companies risk is the risk that the life insurance company may run into financial difficulties as a result of its subsidiaries' or any other related entity's financial difficulties. The related company's risk may also arise from a decision made by the controlling company that may be unfavourable to the affiliate. For an insurer, being a part of a financial organization can be a potential source of strength, but it can also pose risks, particularly as a result of contagion. This risk could be easily integrated into other risk categories as a ripple effect and/or management action or be considered as a separate scenario.

Factors to be considered 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 is obliged to continue to 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 in a timely manner a subsidiary that is in financial difficulty, e.g. where the subsidiary shares the same brand, systems and other infrastructure as the insurer;
- the implicit support of group companies through the reallocation of group overheads towards the insurance entity;
- the pressure on the insurer to support other group members financially (e.g., capitalizing subs to meet their local regulatory targets);
- 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; and
- the effect on the insurer of a downgrade in the rating of the group or of other reputational issues.

APPENDIX B

DISCUSSION AND ANALYSIS OF PROPERTY & CASUALTY INSURER RISK CATEGORIES

Paragraph 2530.10 of the Standards of Practice states,

> A plausible adverse scenario is a scenario of adverse, but plausible, assumptions about matters to which the insurer's financial condition is sensitive. Plausible adverse scenarios vary among insurers and may vary over time for a particular insurer.

Generally, it is expected that a plausible adverse scenario would be in the range of a 95th to 99th percentile of outcome. The actuary is expected to develop an understanding of the sensitivity of the insurer's financial condition under each major risk category that is material to the company.

This appendix outlines the major risk categories that could be considered. The actuary would review and assess each of the risk categories and identify those that are relevant to the insurer's circumstances. Some risk categories may not be relevant and would need no analysis whatsoever. Stress testing may be used to determine the relevant risk categories for the company.

For each of the relevant risk categories requiring further analysis, the actuary would assess all the scenarios listed to determine the plausible adverse scenarios that are likely significantly to affect surplus or that may cause the insurer to fall below the minimum regulatory capital during the forecast period. Stress testing may also be used to determine the relevant adverse scenarios.

The actuary would then develop and model the relevant adverse scenarios in detail. The relevant scenarios may be single risk scenarios or integrated scenarios resulting from a combination of single risk scenarios. Associated ripple effects triggered by an adverse scenario would also be identified and modeled as part of the relevant scenario. Examples of possible ripple effects are shown for each risk category in this appendix. Similarly, possible management actions in response to an adverse scenario would be identified and modeled as part of the relevant scenario. Examples of possible management actions are also listed for each risk category.

For any relevant scenario, the actuary may consider stress testing to determine the extent to which the risk factor(s) in question has to be changed in order to drive the insurer's surplus negative during the forecast period, or to determine the 95th to 99th percentile. Depending on the insurer's circumstances, the Board or Chief Agent and management may also be interested in various levels of "unsatisfactory" condition, in which case further stress testing may be beneficial.

Once the relevant scenarios are tested, the actuary would then select at least three plausible adverse scenarios, from those modeled, showing the greatest surplus sensitivity for inclusion in the DCAT report. For any plausible modeled scenario that causes the insurer to fall below the minimum regulatory capital during the forecast period, the actuary would discuss possible regulatory actions and repercussions with management

and include the scenario in the report. Similarly, for any plausible modeled scenario that may trigger rating agency actions, the actuary would discuss those with management.

Paragraph 2530.13 of the Standards of Practice states that the actuary would test threats to the insurer's financial condition under plausible adverse scenarios that include, but are not limited to, the risk categories that are listed in this appendix. The same is true of the possible adverse scenarios described for each risk category – they are illustrative but not exhaustive. For example, two types of risks not included are expense risk and operational risk. Scenarios arising due to expense risk are not common for most P&C insurers but may be significant for a company that is just starting up or winding down operations. Also, operational risk is an evolving area and the actuary may be obliged to consider scenarios such as a major shut-down of operations or loss of a key individual in the organization.

If the P&C insurer manages life business and that life business represents a material risk for the company, the actuary would consider all the risk categories covered in the life appendix of this educational note. If the actuary does not consider the life risk important, an explanation would be provided indicating why it is not.

1. Claim Frequency and Severity Risk

An insurer's financial condition may be sensitive to increases in claim costs (including loss adjustment expenses). Future claims costs and loss ratios can differ significantly from the base scenario due to:

- **Single catastrophic event** – The actuary would consider natural disasters (e.g., earthquakes, windstorms, floods, and hail), manmade events (e.g., terrorism) or any other single event affecting multiple policyholders that could have a material impact on the insurer's financial condition. The actuary would ensure consistency with any minimum return period for an earthquake event that may be required by the regulator.
- **Single large claim** – The actuary would consider the effect on the insurer's financial condition if its policy/account with the largest probable maximum loss (PML) has a "full PML" event.
- **Multiple catastrophic events** – The actuary would consider two or more events affecting multiple policyholders where the joint probability of the events is approximately equal to the probability of a single catastrophic event.
- **Multiple large claims** – The actuary would select the size of claim that would be considered by the insurer to be large. The size would depend on the size of the insurer and will generally be smaller than the insurer's net retention. Using historical claims trended to current levels and adjusted for the insurer's current exposure, the actuary would estimate the frequency and severity distribution of these claims. The cumulative distribution may be estimated using assumed distributions or simulation techniques. The cumulative distribution would be constructed for net and gross claims. The adverse scenarios will generally be based on the difference between the claims in the 95^{th} to 99^{th} percentile range and the expected large claims (which are assumed to be already included in the base scenario).

- **Other frequency and severity** – The actuary would model the loss ratio or frequency and severity of claims. Since catastrophes, large claims and adverse development are considered in other scenarios, the actuary could remove unusual claims from the data prior to their analysis. It is generally recommended that the variability of the normal accident year or underwriting year loss ratio, or the combined frequency and severity distribution be examined. The actuary may assume a distribution of claims and determine the 95th and 99th percentiles.
- **Social Inflation** – Social inflation refers to the claims inflation resulting from changes in the likelihood of claimants bringing suit, the size of awards, the standards of liability or the attitudes of claimants towards settlement of their claims. A significant sustained increase in the rate of social inflation would tend to lead to increases in the ultimate number or severity of unpaid liability claims and increases in the number or severity of future liability claims (both those related to the runoff of the unearned premium, and those related to future new and renewal business). It would not normally be linked to a change in market interest rates.

Possible ripple effects may include:

- insolvency of one or more reinsurers accounting for a significant portion of the insurer's reinsurance coverage;
- increases in the policy liabilities related to current reinsurance contracts which are swing-rated, have variable commission, or require reinstatements;
- loss of reinsurance coverage for remainder of term;
- increases in reinsurance rates or non-availability of reinsurance at the next renewal;
- post-event inflation (i.e., a significant temporary increase in the cost of labour and materials) following a catastrophe resulting in increases to the ultimate cost of unpaid claims as well as future claims;
- post-event inflation in regions not directly affected by the catastrophic event;
- forced sale or liquidation of assets;
- increased Property and Casualty Insurance Compensation Corporation (PACICC) assessments resulting from failure of other insurers; and
- rating agency downgrade.

Possible management actions may include:

- reviewing reinsurance coverage, type or contract terms at renewal;
- implementing rate increases, where possible;
- restricting writing in hazard prone areas;
- reviewing the target mix by line of business or jurisdiction;
- reviewing the type of products offered, such as writing more subscription policies; and
- selling or reinvesting assets.

2. Policy Liabilities Risk

Policy liabilities are estimates of future amounts required to pay for claim liabilities and premium liabilities. Significant underestimation of these amounts may adversely affect the insurer's financial condition. For long tail lines, estimates of the cost of future claims may depend upon the estimates of the unpaid claim liabilities. As such, underestimating the policy liabilities may have a concomitant effect on the estimates of future claims.

Where the underestimation of policy liabilities results from the occurrence of a catastrophe, this scenario would normally be covered under risk category 1 (claim frequency and severity risk). Where the underestimation results from legislative change(s), this scenario would normally be covered under a scenario from risk category 7 (government and political risk).

Examples of adverse scenarios to which an insurer's financial condition may be sensitive include:

- **selection of inadequate loss development factors,** especially for new products or lines subject to legislative changes for which long-term development patterns are not available;
- **class actions and other mass torts,** effective retroactively;
- **change in mix of business** where a shift to longer tailed lines of business may result in adverse development if selected loss development patterns do not reflect the shift;
- **claims paid faster than assumed** in the base scenario, especially if large claims are paid earlier; and
- **actual rate of return on investments supporting the liabilities significantly lower than assumed** in the base scenario.

Possible methods to determine the 95th to 99th percentile range include:

- modeling the loss development factors with a statistical distribution and estimating the unpaid claims with factors at the 95th to 99th percentile; and
- analyzing the company's history of actual to expected development of unpaid claims. This would generally be done for all lines of business combined, although an analysis by lines of business may be appropriate for a company where the mix of business has changed significantly over the years. It may be appropriate to use industry data for a new company, or if the company has a significant volume in new lines of business. In estimating the 95th to 99th percentile range, the actuary may want to fit a distribution to the historical runoff data.

Stress testing may be useful to determine the magnitude of an understatement of unpaid claim liabilities or of an unanticipated large payment that would result in unsatisfactory financial condition for the company.

Possible ripple effects may include:

- the effect on actuarial present value for scenarios affecting undiscounted policy liabilities;

- increases in the policy liabilities related to current and past reinsurance contracts which are swing-rated, have variable commission, or require reinstatements;
- increases in ultimate claim costs and claim expenses in connection with the runoff of the unearned premium for scenarios affecting claims liabilities;
- increases in ultimate claim costs and claim expenses in connection with future new and renewal business;
- forced sale or liquidation of assets; and
- rating agency downgrade.

Possible management actions may include:

- settling claims faster by minimizing litigation or fast tracking claims handling;
- reviewing reserving and claim settlement guidelines;
- implementing rate increases, where possible; and
- reviewing the target mix by line of business or jurisdiction.

3. Inflation Risk

Claim costs and claim adjustment expenses are quite sensitive to inflation as it affects the insurance environment. Inflation in the insurance environment will generally be positively correlated with the general rate of inflation as measured by the Consumer Price Index. There will, however, be changes in costs that will affect the insurance environment differently than the overall economy.

Claim costs may be affected by price increases extraneous to the insurance business. This excludes the effect of social inflation that is considered in risk category 1 (claim frequency and severity risk). Changes in inflation may be due to:

- **A significant, rapid and sustained increase in the general rate of inflation** – In this scenario, inflation will lead to increases in the ultimate cost of settling claims (incurred and unpaid as well as future claims) as well as various related expenses. It would normally, but not always, be linked to a rapid and sustained increase in market interest rates.

  A scenario considering sustained inflation will tend to be based on a significant increase in trend over inflation projected in the base scenario. Ideally, the increase would be applied over the entire projection period. This would tend to be accompanied by an increase in market interest rate.

  A possible method to determine an adequate level of increase in the inflation trend would be to look at historical changes in the CPI index over three-year periods over time. The length of time considered would ideally be long enough to capture a large range of situations that can be applied to the projection period. The level of change in market interest rate would be based on the reasoning described in risk category 6 (investment risk).

- **A significant temporary increase in the cost of labour and materials following a catastrophe or other major event** – In this scenario, the ultimate cost of settling claims would increase following a catastrophe or other major

industry event that did not directly affect the insurer. This scenario differs from the ripple effect for catastrophic event(s) in risk category 1 (claim frequency and severity risk) because the increased cost affects claims that were not the result of the event.

- **A severe recession in the economy** – In this scenario, economic conditions may lead to increases in the ultimate number of and cost of settling claims and loss adjustment expenses, for both current and future claims. This may be linked to a sustained increase in general inflation, unemployment level or market interest rates.

Possible ripple effects may include:

- a rapid and sustained increase in market interest rates;
- increase in operating expenses; and
- increase in reinsurance rates on current swing-rated contracts and on future contracts.

Possible management actions may include:

- reviewing reinsurance coverage, type or contract terms at renewal;
- implementing rate increases, where possible;
- reviewing the target mix by line of business or jurisdiction;
- reviewing the type of products offered;
- selling or reinvesting assets; and
- adjusting the insurance to value or cost calculator.

4. Premium Risk

An insurer's financial condition may be affected by differences between actual business volume, type or mix and the respective assumptions in the business plan.

There are several categories of events that could have considerable impact on the volume, type, mix and profitability of business written by an insurance company. Some of these events are related to the underwriting and marketing environment and can result in unexpected reductions or increases in premium volume. Inadequate pricing may also trigger significant changes in the premium volume or mix of business and is likely to compound the effect of scenarios triggered by other events. Any significant change in premium volume resulting from government or political actions would be considered under risk category 7 (government and political risk).

Stress testing may be useful to determine the magnitude of premium volume that would result in an unsatisfactory financial condition for the insurer. Consideration would be given to the assumptions in the base scenario, and vulnerability of the insurer to the selected event given its size, marketing plan and strategies.

Premium volume significantly lower than the base scenario

The reduction from the planned premium volume can be the result of lost business, reduced or inadequate rate level for some market segments and/or uncompetitive pricing in some market segments.

Some events resulting in a significant reduction in premium volume include:

- entry of a new and strong competitor into a market;
- increased competitiveness in a market;
- loss of a key distributor, or even an entire distribution channel;
- loss of a key client;
- action by any influential entity (consumers, distributors, rating agencies, etc.) that affects the company's reputation or growth negatively;
- inability to implement planned premium rate increases; and
- noncompetitive premium rates.

Possible ripple effects may include:

- an increase in loss ratio due to a soft market, inadequate pricing or lost business that is relatively more profitable than the retained business;
- an increase in the fixed expense ratio;
- an increase for certain types of expenses (for example: more advertising costs to counter a very aggressive competitor);
- a shift in portfolio mix since the lost business could have a much different average premium or could be primarily from a specific market segment;
- an increase in reinsurance costs as a percentage of subject premium; and
- forced sale or liquidation of assets.

Possible management action may include:

- reducing personnel or slowing down hiring;
- identifying other distributors for the company's product(s);
- implementing rate changes, where possible;
- changing reinsurance coverage, type or contract terms at next renewal;
- underwriting actions in markets subject to increased competition;
- changing the target mix of business of future lines of business; and
- adjusting the investment portfolio to mitigate cash flow strains.

Premium volume significantly higher than the base scenario

An increase from the planned premium volume can be the result of unexpected new business or inadequate (i.e., too competitive) rate level for some market segments.

Some events resulting in a significant increase in premium volume include:

- withdrawal or failure of major competitors from a market;
- appointment of a key distributor;
- unexpected new business from a large client;
- any action by any influential entity (consumers, distributors, rating agencies, etc.) that affects the company's reputation or growth favourably;
- unexpected success in a new product area, or against previously stronger competition; and
- premium rates set too low compared to the competition.

Possible ripple effects may include:

- a higher loss ratio on new business due to inadequate pricing;
- a shift in portfolio mix since the new business could have a much different average premium or could be primarily from a specific market segment;
- higher expenses (hiring of employees, increased overtime, etc.) in the short term as well as in the long term;
- increased PACICC and pool assessments; and
- increased reinsurance costs.

Possible management action may include:

- implementing rate changes, where possible;
- underwriting actions (e.g., restrictions on new business, withdrawal) in unprofitable markets;
- reviewing the distribution channels;
- reducing certain types of expenses (for example, advertising costs); and
- using reinsurance to mitigate capital strain.

5. Reinsurance Risk

An insurer's financial condition may be adversely affected by a reinsurer's failure to meet its obligations to the insurer, or from a change in market conditions causing an increase in reinsurance rates, inadequate reinsurance limits, or otherwise inadequate or unaffordable reinsurance coverage. In this context, the term "reinsurer" is intended to include both reinsurers, if the company is a primary insurer, or retrocessionaires, if the company is itself a reinsurer.

Adverse scenarios arising from reinsurance risk include:

- **Reinsurer insolvency** - The impact of reinsurer insolvency would reflect an assumed "recoverable percentage" of assets to liabilities of the failed reinsurer, and any different treatment of various types of amounts owing from the reinsurer to the company. The impact may be mitigated by right of offset to amounts owing under all treaties between the two companies, by the preferred position insurers will have relative to other creditors of a failed reinsurer, by the special termination

clause in the event of failure, and by any amounts on deposit or in trust with the insurance company, or letters of credit in respect of an unlicensed reinsurer. It would normally be appropriate under this scenario to assume that the business currently ceded to the failing reinsurer could be successfully reinsured elsewhere (possibly on less favourable terms), unless there is something unique about the business involved that would make securing such replacement reinsurance difficult.

Reinsurer insolvency can be due to the circumstances of a specific reinsurer (such as, under-valuation of older liabilities), or it could be systemic to the industry due to a major global event, or series of global events (e.g., terrorist attack, natural disaster, etc.). In developing this scenario, the actuary would take into account the following considerations:

- Affiliated versus non-affiliated reinsurers – the actuary may be better able to assess the likelihood of insolvency if a reinsurance arrangement consists of an inter-company pooling agreement or reinsurance with an affiliated company, as opposed to external reinsurance;
- Rating of reinsurers – reinsurers with weaker rating from rating agencies could be more likely to fail than reinsurers with stronger rating;
- Registered versus non-registered reinsurers – although non-registered reinsurers may have deposits in Canada covering known liabilities, access to funds to cover unknown liabilities may be more difficult to secure; and
- Concentration of reinsurance – this involves the failure of a reinsurer with a significant share of the ceded liabilities.

Stress testing may be useful to determine a plausible scenario. The actuary would calculate the exposure to the reinsurers in terms of unpaid claims, including incurred but not reported (IBNR), but less amounts payable to, and security held from, the same reinsurers. The actuary may evaluate the impact of default of some of these reinsurers based on level of participation, financial stability and rating.

- **An increase in reinsurance rates or a reduction in reinsurance commission** - This scenario considers situations where reinsurance action is systemic in nature, due to the overall insurance environment. This is in contrast with ripple effects considered in risk categories 1, 2 and 4, where the reinsurer action is taken in response to situations unique to the insurer, such as poor experience.
- **Reduction in capacity** - This scenario contemplates a reduction in the availability of reinsurance over the forecast period.
- **Disputes over policy conditions** - The effect on a company of disputes with reinsurers may be similar to the effect of reinsurer insolvency. To differentiate between these scenarios, however, the actuary would consider a dispute that results in a principal reinsurer denying coverage for a significant class of business or category of claims, such as a terrorism occurrence.

Possible ripple effects may include:

- increase in reinsurance rates arising from the need to obtain replacement reinsurance coverage; and
- reduced availability of reinsurance.

Possible management actions may include:

- changing the reinsurance structure;
- diversifying participants on the reinsurance program;
- retaining a greater proportion of business to decrease the reinsurance cost;
- changing reinsurers; and
- reducing primary policy limits.

6. Investment Risk

Changes in economic conditions have the potential to significantly impact an insurer's financial situation. For example, rapid changes in interest rates, exchange rates and economic growth rates can affect the insurer's financial condition by leading to concomitant changes in:

- the market value of debt and equity securities;
- the default rates on debt securities; and
- the match between cash flows from assets and liabilities.

Adverse scenarios in respect of deterioration of asset values may come from a variety of sources, including:

- a significant change in the yield curve;
- an increase in the default rate on debt securities;
- a decrease in the returns and/or value of equities;
- a decrease in the returns and/or value of real estate;
- a decrease in the returns and/or value of subsidiary;
- a significant change in foreign exchange rates; and
- a decrease in the returns and/or value of other major asset categories.

The actuary may consider integrated scenarios involving a combination of these events.

In selecting appropriate assumptions to determine the 95th to 99th percentile range, the actuary may want to refer to the CIA's Canadian Economic Statistics. For example, the actuary may base his or her assumption on the largest one-year decline in equities, or the largest three-year average increase in interest rate. It is important, however, to keep in mind the starting position of the current economic environment. Alternatively, the actuary may use a stochastic model for economic changes, if one is available.

Possible ripple effects may include:

- forced sale or liquidation of assets;

- significant positive or negative cash flows impacting the company's liquidity position;
- negative change on derivative positions;
- default by counter-party on derivatives;
- rating agency downgrade;
- a liquidity crisis caused by large, sustained default losses;
- increase in the frequency or severity of claims due to the deteriorating economic conditions; and
- change in discount rate used for calculating actuarial present value of policy liabilities.

Possible management actions may include:

- selling or reinvesting assets;
- changing the investment strategy;
- repositioning derivative tools;
- reducing the amount of business underwritten;
- implementing rate increases, where possible; and
- reducing costs through layoffs, consolidation of branch offices, or other similar actions.

7. Government and Political Risk

The implementation of a government's policies or regulations usually takes a long time. This normally allows an insurer time to analyze the impact(s) and take the appropriate actions. Time for analysis and action may not be available where implementation of changes occurs quickly, is not foreseen, or is made retroactively effective. In these cases, the adverse scenario may be modeled in the stub year if the scenario is plausible in that time period.

Adverse scenarios to which an insurer's financial condition may be sensitive include:

- a rate freeze or rollback of rates by a government body or regulator on lines of business and jurisdictions in which rates are subject to regulatory approval;
- a change to regulations regarding use of rating variables that may impact the adequacy of rates and availability of insurance on lines of business and jurisdictions in which rates are subject to regulatory approval;
- a change to legislation that prescribes levels of insurance coverage, such as automobile accident benefits;
- an increase in taxation rates or rules for corporations, such as income tax, capital gains tax deductions or offshore income;
- nationalization or privatization of a line of business in a jurisdiction;
- a change to legislation that creates or restricts distribution channels;

- a change in regulatory solvency standards that could increase the capital requirements for property and casualty insurers; and
- political instability that leads to confiscation of assets, closure for new business, exchange controls, etc., particularly in foreign jurisdictions.

Possible ripple effects may include:

- deterioration of loss ratios;
- increased litigation costs;
- reduced availability of insurance to the public;
- increased volume of industry pools resulting in increased assessments;
- increased regulatory monitoring, or filing of rates;
- forced sale or liquidation of assets;
- problems with reinsurance coverage;
- increased policy liabilities related to current reinsurance contracts which are swing-rated, have variable commission, or require reinstatements; and
- increased reinsurance rates or non-availability of reinsurance at the next renewal.

Possible management actions may include:

- reducing the volume of business written by restricting sales or broker force, freezing new business or withdrawing from the jurisdiction or line of business;
- creating or expanding a separate company or distribution channel;
- reviewing the target mix by line of business or jurisdiction; and
- reviewing reinsurance coverage type or contract terms at next renewal.

8. Off-Balance Sheet Risk

There are numerous off-balance sheet items that may adversely affect on an insurer's financial conditions. Often these off-balance sheet items arise from new or evolving industry practices that, in subsequent years, do get recognized on the balance sheet by the Canadian Institute of Chartered Accountants, the CIA or regulators. Therefore, the actuary needs to develop awareness of any emerging risk that may be relevant to the insurer during the forecast period and assess its potential threat to the insurer's financial condition.

Possible scenarios of off-balance-sheet items and their related risks include:

- **Structured settlement** – When a property and casualty insurance company purchases an annuity to satisfy a structured settlement, it is exposed to the credit risk associated with the insolvency of the annuity company.
- **Contingent liabilities or losses** – There are a variety of contingent liabilities to which a company may be exposed, such as tax, litigation, etc.

- **Letters of credit and pledged assets** – The insurer may be exposed to the risk that a lending institution defaults on payment under, for example, a letter of credit, or a call on assets pledged.
- **Capital maintenance agreements** – An insurer could be exposed to capital maintenance agreements it must honour for its subsidiaries.
- **Derivative instruments** – The risks associated with derivatives include market risk, default risk, management risk and legal risk and are discussed in more detail below:
    - Market risk includes liquidity risk and basis risk. Liquidity risk is the risk of not being able to cancel or unwind one's contract when desired or at a favourable price. Basis risk is the risk that the derivative's price behaviour does not act as expected undoing the intended hedging benefits. The price behaviour of the instruments can change adversely when market conditions change. Market risk is best evaluated on a security basis and on a portfolio basis since some risks may not net against each other.
    - Default (or credit) risk is the risk that a loss will be incurred due to default in making the full payments, when due, in accordance with the terms of the contract.
    - Management risk is the potential for incurring material, unexpected losses on derivatives due to inadequate management supervision and understanding, systems, controls, procedures, accounting and reporting.
    - Legal risk is the risk that the derivative agreement is not binding as intended.
- **Pension Underfunding** – The insurer could be exposed to the potential impact of unfunded liabilities.

Possible ripple effects may include:

- forced sale or liquidation of assets; and
- significant positive or negative cash flows, affecting the insurer's liquidity position.

Possible management actions may include:

- changing the pension plan from a defined benefit to a defined contribution;
- selling or reinvesting assets;
- changing the reinsurance strategy;
- repositioning of derivative tools;
- reducing costs through layoffs, consolidation of branch offices, or other similar actions.

9. Related Company Risk

It is possible that adverse scenarios in a related company may have a concomitant impact on the insurer's financial condition. The choice of adverse scenarios for this risk will tend

to be based on actual company organizational structures. Related company risk may also be considered in creating integrated scenarios with other risk categories.

In this context, an insurer's financial condition may be sensitive to:

- **a reduction in reliance on the parent company for financial support** – typically, such a situation would arise when a group's financial resources are needed to support a financially impaired parent or affiliate company;
- **an increase in the provision of financial support to the parent** – in this situation, funds the company expected to have for its own purposes are now needed to support other entities in the group;
- **a high level of dependency on group operational resources** – this situation would consider disruptions in services (computer systems, actuarial, etc.) provided by related companies; and
- **a rating agency downgrade reflecting difficult financial conditions at the group level.**

Possible ripple effects may include:

- management focus on group rather than company priorities, potentially delaying remedial action;
- a need to provide for service disruptions; and
- regulator action to protect local policyholders.

Possible management actions may include:

- finding alternative sources of funds for operational support;
- adjusting premium volumes and mix of business;
- reviewing reinsurance coverage purchased to mitigate capital strain;
- reviewing the target mix by line of business or jurisdiction;
- reviewing type of products offered; and
- selling or reinvesting assets.