
ACTUARIAL GUIDANCE NOTE

AGN 7 DYNAMIC SOLVENCY TESTING

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AGN 7 DYNAMIC SOLVENCY TESTING

Introduction

This Actuarial Guidance Note comprises two parts – Requirements (Part I) and Explanatory guidelines (Part II).

With effect from 31 December 2016, the previous AGN 7 on Dynamic Solvency Testing (effective from 2011) shall be cancelled, and this Actuarial Guidance Note shall come into force.

Part I –Requirements

1. Scope

This guidance note applies to the Appointed Actuary (the “Actuary”) of an Insurer (the “Insurer”) when preparing a Dynamic Solvency Testing Report on the Insurer’s financial condition for the Board of Directors. This Actuarial Guidance Note applies to the Long Term business written in or from Hong Kong.

2. Investigation

- 2.1 Subject to the explanatory guidelines provided in Part II, the Actuary must make an annual investigation of the Insurer’s projected financial position and condition of the Long Term business, must use appropriate scenarios for the investigation and must produce and sign-off a written report faithfully representing the work carried out.
- 2.2 The report of each investigation should be made available to the Insurer's Board of Directors. The report should identify any threat to satisfactory financial condition that the investigation reveals and possible actions for dealing with these threats.
- 2.3 The Actuary should also conduct an interim investigation if there is a material adverse change in the Insurer's circumstances.
- 2.4 The Actuary should specifically highlight any area where the Actuary gives advice which is not consistent with this guidance note. Adequate records should be kept to justify any departure from the guidance note.

3. Method

3.1 Current Financial Position

The report should include an outline of the current financial position and underlying valuation basis, including special reserves.

There should be a discussion of the difference between the current position and the position projected in the base scenario in the previous year's report.

3.2 Dynamic Solvency Testing

3.2.1 Dynamic Solvency Testing (“Solvency Testing”) examines the effect of various plausible adverse scenarios on the Insurer’s projected capital adequacy. It is one of the Actuary’s primary tools for investigating an Insurer’s financial condition.

3.2.2 The purpose of Solvency Testing is to identify:

- the capital adequacy position of an Insurer on an ongoing concern basis;
- plausible threats to the Insurer’s future financial position;
- actions which lessen the likelihood of those threats; and
- actions which would mitigate the impact of a threat if it materialized.

3.2.3 Solvency Testing is defensive, i.e. it addresses threats to financial condition rather than the exploitation of opportunity.

3.3 Satisfactory Financial Condition

The Insurer’s financial condition is satisfactory if:

- under the base scenario, it meets the minimum regulatory capital requirement throughout the forecast period, i.e. insurer’s having an excess of assets over liabilities by an amount of applicable solvency margin; and
- under all the tested prescribed and plausible adverse scenarios, the Insurer's assets exceed liabilities throughout the forecast period.

3.4 Forecast Period

Solvency testing results should be reported for every year-end throughout the forecast period, with the forecast period beginning at the most recent financial year-end balance sheet date. The forecast period for a typical life Insurer would be three financial years. The forecast period should be extended to five financial years if there is reasonable indication that a capital adequacy problem is likely to occur after three financial years. In addition, actual capital positions for the two years immediately preceding the forecast period should be presented.

3.5 Scenarios

The scenarios consist of a base scenario, six prescribed simple scenarios, at least three compound scenarios and the applicable additional plausible adverse scenarios. Each scenario takes into account:

- not only enforce policies but also the policies assumed to be sold during the forecast period; and
- the events and/or business operations that may adversely impact the financial condition of the long term business.

3.6 Base Scenario

The base scenario is a best estimate¹ 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.

If the business plan is completed before the reporting date, the Actuary should allow for any material difference between the actual position of the Insurer at the reporting date, and the position projected in the business plan. The Actuary would normally accept the business plan's assumptions for use in the base scenario, unless these assumptions are inconsistent or unrealistic enough to potentially result in misleading figures being reported. However, if there is any material new information available at the time the Solvency Testing is conducted, the information should be included in the base scenario. The Actuary should report any material inconsistency between the base scenario and the business plan.

The Actuary should ensure that:

1. the projections are comprehensive in scope, covering all key products and lines of business, and all assets that are material to the solvency of the Insurer;
2. separate projections are made for each insurance fund established and maintained by the Insurer;
3. in circumstances where the assets or liabilities of an insurance fund (that are material to solvency) have different inherent characteristics, there are separate projections by major product line and asset class within the insurance fund; and
4. adequate checks are conducted on the appropriateness of any data or projections that form the basis for the Solvency Testing report.

3.7 Prescribed Scenarios

3.7.1 Simple Scenarios

The Actuary should separately test the following six simple scenarios.

A. Throughout the forecast period, allow for:

- 15% deterioration in mortality rates for life business / endowment business;

¹ For guidance on "best estimate" assumptions, refer to AGN 9

-
- 15% deterioration in morbidity rates;
 - 15% increase in incidence rates for disability, accident and sickness; and
 - 15% improvement in mortality for annuity business.
- B. Throughout the forecast period, allow for an increase or decrease in lapse rates of 5%, depending on which alternative produces the most adverse results, by product.
- C. Throughout the forecast period, (and commencing immediately after the valuation date) allow for:
- interest rates to be set to 70% of the rates projected in the base scenario; and
 - equity and real estate market values fall by 25% in the first year, and thereafter grow at the same rate as the base scenario.

Any fixed-income asset, such as bond and mortgage, should be re-valued to reflect consequent changes in values as appropriate under the Insurer's accounting policy. If the liabilities' valuation interest rates are changed then this needs to be stated.

- D. Throughout the forecast period, (and commencing immediately after the valuation date) allow for:
- interest rates to be set to 130% of the rates projected in the base scenario, or at the base scenario rates plus 2% if greater; and
 - equity and real estate market values fall by 25% in the first year, and thereafter grow at the same rate as the base scenario.

Any fixed-income asset, such as bond and mortgage, should be re-valued to reflect consequent changes in values as appropriate under the Insurer's accounting policy. If the liabilities' valuation interest rates are changed then this needs to be stated.

- E. High growth throughout the forecast period, with sales growth rate being 30%, or 150% of plan growth rate if higher, and with a reasonable increase in expenses, consistent with the higher growth.
- F. Low growth throughout the forecast period, with year 1 sales being 80% of current year, followed by 20% drop for years 2 and 3, without any saving in expenses other than commission and commission-related expenses that are directly related to the new sales volume.

3.8 Plausible Adverse Scenarios

3.8.1 Compound Scenarios

In addition to the six prescribed scenarios above, the Actuary should test at least three short-term or medium-term compound scenarios.

There are three example scenarios listed in Explanatory Guidelines (Item G, H and I). The Actuary may substitute alternative compound scenarios that are more relevant to the Insurer.

3.8.2 Additional plausible adverse scenarios

The Actuary should consider testing additional plausible adverse scenarios where each additional scenario contains plausible adverse assumptions about matters to which the Insurer's financial condition is sensitive. There are two scenarios listed in Explanatory Guidelines (Item J and K). The Actuary should consider these two scenarios where applicable. Plausible adverse scenarios vary among Insurers and may vary over time for a particular Insurer. In many cases, plausible adverse scenarios are associated with a low probability of occurrence, but the potential financial impact could be severe.

3.9 Ripple Effects

The Actuary should consider "ripple" effects. Although most of the other assumptions used in the base scenario may remain appropriate in the prescribed and plausible adverse scenarios, some may need adjustments to reflect the interdependence of assumptions in the plausible adverse scenarios, for a more internal consistent set of assumptions. The possible actions to be initiated by the external bodies have been provided in the relevant section in Part II, while a list of items to be considered for assumptions adjustment has also been provided in Appendix 2 of Part II.

3.10 Scope of the Investigation and Report

3.10.1. The report should contain the key assumptions of the base scenario and all other tested scenarios posing the greatest risks to the satisfactory financial condition of the Insurer. The report should also include comments on major risks faced by the Insurer. The meaning of satisfactory financial condition is defined in paragraph 3.3 of this guidance note.

3.10.2. The report should also state which of the plausible adverse scenarios examined would cause the Insurer to fall below the minimum regulatory capital requirement. Even though the Actuary may have signed a satisfactory financial condition opinion, the report should make it clear that under these scenarios the regulators may impose restrictions on the operations of the Insurer, including its ability to write new business.

3.10.3. For each of the plausible adverse scenarios reported upon, the Actuary should also report the results without the effect of any extraordinary management action and without the effect of any regulatory action.

3.10.4. The Actuary should consider the effects of the Insurer's valuation and accounting bases, including any taxation impact, and these should be included in the testing and reporting.

3.10.5. If the investigation identifies any plausible threat to satisfactory financial condition, then the Actuary should identify potential management action which would lessen the likelihood of that threat, or which would mitigate that threat, if it materialized.

3.11 Revaluation of the Assets

Invested assets whose values depend on interest rates should be revalued throughout the forecast period, in accordance with changing interest rates in each scenario. Financial instruments whose values depend on other market factors should be similarly revalued throughout the forecast period, in accordance with changes in those factors in each scenario.

3.12 Revaluation of the Policy Liabilities

Ideally, for each adverse scenario, the policy liabilities and the minimum regulatory capital requirement should be revalued throughout the forecast period in order to be consistent with the projected assumptions at each point of time in each scenario. Revaluation only at the end of the forecast period may be a suitable compromise, provided the Actuary is confident, given the projected position at the end of the forecast period in that scenario, that the Insurer's assets would exceed its liabilities throughout the forecast period if revaluation were performed every year. Existing revaluation practice of the Insurer should be considered.

3.13 Interim Investigation

In rare cases, a material adverse change in the Insurer's circumstances since the last annual investigation may be so far reaching that to delay reporting Solvency Testing results to the time of the next annual investigation would be imprudent. For example, failure to meet the minimum applicable regulatory capital requirement, or adoption of a radically different business plan, may trigger the need for an immediate report. In such a case, the Actuary should undertake and report an interim investigation.

4. Reporting

4.1 The Actuary should submit the report to the Board of Directors.

4.2 In order to give the Insurer's management an opportunity to react to the results of the investigation, the Actuary would normally discuss the report with the Insurer's senior management in advance of its submission.

4.3 An interpretative report is more useful than a statistical report.

4.4 The timing of the report depends on the urgency of the matters reported, and on the desirability of integrating Solvency Testing into the Insurer's annual financial planning cycle. The annual report in writing should be completed and available to the Board within 6 months of each financial year-end. The report should take into account post-valuation date events, if significant.

5. Opinion

- 5.1 The report should contain an opinion signed by the Actuary. The purpose of the opinion is to report on the financial condition of the Insurer.
- 5.2 The wording of the opinion follows: (insert appropriate wording where indicated by [square brackets])

"I have completed my annual investigation of the financial condition of [company name] as at [date] in accordance with accepted actuarial practice.

I have analyzed the projected financial positions of the company during the [number] year projection period under a series of scenarios. A description of these scenarios and their impact on the company is included within this report.

The analysis incorporates assumptions relating to business growth, investments, [mortality, morbidity, claims frequency, capital injections, other policy-related experience] and other internal and external conditions during the forecast period, as well as potential management responses to various plausible adverse scenarios. The most significant assumptions are described within this report.

In my opinion, the financial condition of the company [is satisfactory under these assumptions or is not satisfactory for the following reasons...]. The term "satisfactory financial condition" in this report means that throughout the forecast period, the company's assets exceed the liabilities under all tested prescribed and plausible adverse scenarios, and meets the minimum regulatory capital requirement under the base scenario.

"I have complied with Actuarial Guidance Note 7 on Dynamic Solvency Testing issued by the Actuarial Society of Hong Kong in carrying out this investigation for the company."

OR

"I have complied with Actuarial Guidance Note 7 on Dynamic Solvency Testing issued by the Actuarial Society of Hong Kong in carrying out this investigation for the company except with the deviations as set out below: [.....]"

[signature of Actuary]

[typed name of Actuary]

[report date]"

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- 5.3 If the Insurer's financial condition is deemed unsatisfactory, the Actuary should report an unsatisfactory opinion.

The Actuary should also report any plausible adverse scenario that may cause the Insurer to fall below the minimum regulatory capital requirement. Even though the Actuary may have signed a satisfactory financial condition opinion, the report should make it clear to the board that the Insurance Authority may exercise his powers of intervention which include, among other things, restriction on new business under these scenarios in the absence of capital enhancements.

***** END OF ACTUARIAL GUIDANCE NOTE – Part I *****

Part II – Explanatory Guidelines

1. General

Scope

For avoidance of doubt, this Actuarial Guidance Note will apply to the Long Term business of an Insurer if it is incorporated in Hong Kong. For an Insurer incorporated outside Hong Kong, this Actuarial Guidance Note will apply to the Long Term business written through its establishment in Hong Kong.

Although this Actuarial Guidance Note does not apply to the General business of an Insurer, the net assets of General business could be used to help meeting the capital adequacy requirements. All assets would be subject to the effects of the asset shocks in each scenario.

In some cases, business lines of an Insurer may be excluded from Dynamic Solvency Testing:

1. business lines that the Actuary considers to be immaterial;
2. business lines with capital levels so high that there is no plausible threat to capital adequacy.

In such cases, the Actuary should describe the standard of materiality in the report, and discuss it with the Insurer's management

Actuary

Actuary refers to the Actuary appointed under section 15(1)(b) of the Insurance Companies Ordinance or any subsequent amendment or replacement legislation.

“if the insurer carries on long term business, an actuary possessing the prescribed qualifications or who is acceptable to the Insurance Authority, as actuary to the insurer, and whenever any such appointment comes to an end the insurer shall as soon as practicable make a fresh appointment.”

2. Base Scenario

The description of the Base Scenario should be set out in the Report (see below). In the description, the following specifications or definitions should be provided:

- Non-guaranteed elements: any management action taken on non-guaranteed elements such as policyholders' dividend should be specified in the report
- Yield curve: if the interest rate in the base scenario is inconsistent with both the current level of the yield curve and the forward rates implied by the current yield curve, this should be stated by the Actuary
- Investment return for a bond portfolio: yield for a bond portfolio should be expressed consistently with the accounting basis of the Insurer and be after investment expenses
- Equity and real estate value: the value should be consistent with the accounting basis of the Insurer for assets, such as reported on marked-to-market basis or as amortized book value.
- All material non-economic factors which are used for projection and valuation of assets and liabilities (including assumptions for mortality, morbidity, lapsation and expenses) during the projection period.

3. Prescribed Scenarios

In addition to the descriptions of the six scenarios in Part I, the Actuary should take note of the application and timing of shocks, as well as potential ripple effects to be considered, as described below:

A. Scenario with mortality and morbidity risks

Statement:

“Throughout the forecast period, allow for:

- *15% deterioration in mortality rates for life business / endowment business;*
- *15% deterioration in morbidity rates;*
- *15% increase in incidence rates for disability, accident and sickness; and*
- *15% improvement in mortality for annuity business.*

Description:

For life business, the adjusted mortality rate is calculated as:

$$q'_{x+t} = q_{x+t} * (1 + 15\%) \text{ for all } t \geq 0, 0 \leq q'_{x+t} \leq 1$$

where q'_{x+t} is the adjusted mortality rate, q_{x+t} is the original mortality rate, with x denoting the issue age and t denoting the policy year. For example, a mortality rate of 0.001 may become $(0.001 * 1.15)$ for all the years in the forecast period.

For endowment business,

if it is pure endowment, the adjusted mortality rate is calculated as:

$$q'_{x+t} = q_{x+t} * (1 - 15\%) \text{ for all } t \geq 0, 0 \leq q'_{x+t} \leq 1$$

if it is a combination of life / endowment, the adjusted mortality rate is calculated as:

$$q'_{x+t} = q_{x+t} * (1 + 15\%) \text{ for all } t \geq 0; \text{ or}$$

$$q'_{x+t} = q_{x+t} * (1 - 15\%) \text{ for all } t \geq 0; 0 \leq q'_{x+t} \leq 1$$

depends on whether increase or decrease of 15% produces an adverse result at the end of

the forecast period.

where q'_{x+t} is the new adjusted mortality rate, q_{x+t} is the original mortality rate, with x denoting the issue age and t denoting the policy year.

For disability, accident and sickness, the adjusted morbidity rate or adverse incidence rate is calculated as:

$d'_{x+t} = d_{x+t} * (1 + 15\%)$ for all $t \geq 0$, $0 \leq d'_{x+t} \leq 1$ where d'_{x+t} is the new adjusted morbidity rate or adverse incidence rate, d_{x+t} is the original morbidity rate or incidence rate, with x denoting the issue age and t denoting the policy year. Note that this is the minimum level that should be tested assuming no further deterioration in the recovery or termination rate, but if the impact is significant from those deteriorations, the Actuary should also reflect those into the scenarios appropriately.

For annuity business, the adjusted mortality rate is calculated as:

$q'_{x+t} = q_{x+t} * (1 - 15\%)$ for all $t \geq 0$, $0 \leq q'_{x+t} \leq 1$ where q'_{x+t} is the new adjusted mortality rate, q_{x+t} is the original mortality rate, with x denoting the issue age and t denoting the policy year.

B. Scenario with persistency risks

Statement:

“Throughout the forecast period, allow for an increase or decrease in lapse rates of 5%, depending on which alternative produces the most adverse results, by product.

Description:

For each specific product, the Actuary should first determine whether addition or subtraction of 5% lapse rate produces deteriorating results at the end of the forecast period. This addition or subtraction is subject to the normal limit of 0% or 100%. For example, a 3% lapse rate becomes 8% or 0%.”

If addition produced deteriorating results, adverse lapse rate is calculated as:

$$w'_{x+t} = w_{x+t} + 5\% \text{ for all } t \geq 0, \text{ subject to } [0\%, 100\%]$$

where w'_{x+t} is the new adverse lapse rate in percentage, w_{x+t} is the original lapse rate in percentage, with x denoting the issue age and t denoting the projection year. For example, a 3% lapse rate may become 8% for all the years in the forecast period.

Otherwise if subtraction produced deteriorating results, adverse lapse rate is calculated as:

$$w'_{x+t} = w_{x+t} - 5\% \text{ for all } t \geq 0, \text{ subject to } [0\%, 100\%]$$

where w'_{x+t} is the new adverse lapse rate in percentage, w_{x+t} is the original lapse rate in percentage, with x denoting the issue age and t denoting the projection year.

C. Scenario with drop in interest rates

Statement:

"Throughout the forecast period, (and commencing immediately after the valuation date) allow for:

- *interest rates to be set to 70% of the rates projected in the base scenario; and*
- *equity and real estate market values fall by 25% in the first year, and thereafter grow at the same rate as the base scenario.*

Any fixed-income asset, such as bond and mortgage, should be re-valued to reflect consequent changes in values, as appropriate under the Insurer's accounting policy. If the liabilities' valuation interest rates are changed then this needs to be stated. "

Description:

The interest rates refer to the prevailing yields of the fixed-income assets, if market values are being reported as the assets value under the Insurer's accounting policy. If amortized book values are being reported, then the prevailing yields should only be applied for the new money, while the existing assets portfolio should have their yields remain unchanged.

The adjusted interest rate should be consistent with:

$$i'_t = i_t * 70\% \text{ for all } t > 0$$

where i'_t is the adjusted interest rate, i_t is the interest rate in the base scenario, with t denoting the projection year. For example, a 5% interest rate may become (5%*70%) for all the years in the forecast period. The adjusted interest rates are to be applied to the base scenario assumptions at or immediately after the start of the forecast period, and persist throughout the forecast period.

The adverse equity and real estate value should be consistent with:

$$V'_1 = V_0 * 75\%$$

$$V'_t = V'_{t-1} * (V_t / V_{t-1}) \text{ for all } t > 1$$

where V'_t is the new equity and real estate value, with t denoting projection year. The deterioration of equity and real estate value is thus assumed to occur sometime during the first projection year, and the assets are subject to growth consistent with the base scenario after the end of the first year. For example, if the original equity and real estate value is 100 units, and the base scenario growth rate is 10% throughout the forecast projection period, then the adverse equity and real estate value is (100*75%), (100*75%*110%), (100*75%*110%*110%) in year 1, 2 and 3 respectively of the forecast period.

The equity and real estate value should be consistent with the accounting basis of the Insurer for assets, such as reported on marked-to-market basis or book value. This is to test the matching between assets and liabilities under different interest sensitivities.

Non-guaranteed elements such as dividend yields should be determined according to the best estimate of the Actuary in light of the emerging investment return.

Given that resilience reserves and reserve provisions for Class G Long Term Business determined under GN7 are also established to protect against adverse investment scenarios, the Actuary should consider adjusting projected resilience reserves and GN7 reserves in this scenario, to ensure a proper provision for the same risk.

The Actuary should disclose in a statement whether such reserves adjustments have been made in this scenario. Please note that such adjustments should only be considered for the investment scenarios in this AGN.

D. Scenario with rise of interest rates

Statement:

"Throughout the forecast period, (and commencing immediately after the valuation date) allow for:

- *interest rates to be set to 130% of the rates projected in the base scenario, or at the base scenario rates plus 2% if greater; and*
- *equity and real estate market values fall by 25% in the first year, and thereafter grow at the same rate as the base scenario.*

Any fixed-income asset, such as bond and mortgage, should be re-valued to reflect consequent changes in values, as appropriate under the Insurer's accounting policy. If the liabilities' valuation interest rates are changed then this needs to be stated."

Description:

The interest rates refer to the prevailing yields of the fixed income assets, if market values are being reported as the assets value under the Insurer's accounting policy. If amortized book values are being reported, then the prevailing yields should only be applied for the new money, while the existing assets portfolio should have their yields remain unchanged.

The adjusted interest rate should be consistent with:

$$i'_t = \max(i_t + 2\%, i_t * (1 + 30\%)) \text{ for all } t > 0$$

where i'_t is the adjusted interest rate, i_t is the interest rate in the base scenario, with t denoting the projection year. The adjusted interest rates are to be applied to the base scenario assumptions at or immediately after the start of the forecast period, and persist throughout the forecast period. For example, a 5% interest rate may become $\max[5\%+2\%, (5\%*130\%)]$ (i.e. 7%) for all the years in the forecast period.

The adverse equity and real estate value is calculated in the same way as for the scenario with a fall in interest rates, described above in C.

The equity and real estate value should be consistent with the accounting basis of the Insurer for assets, such as reported on marked-to-market basis or book value. This is to test the matching between assets and liabilities under different interest sensitivities.

Non-guaranteed elements such as dividend yields should be determined according to the best estimate of the Actuary in light of the emerging investment return.

Given that resilience reserves and reserve provisions for Class G Long Term Business determined under GN7 are also established to protect against adverse investment scenarios, the Actuary should consider adjusting projected resilience reserves and GN7 reserves in this scenario, to ensure a proper provision for the same risk.

The Actuary should disclose in a statement whether such reserves adjustments have been made in this scenario. Please note that such adjustments should only be considered for the investment scenarios in this AGN.

E. Scenario with high growth

Statement:

"High growth throughout the forecast period, with growth rate being 30%, or 150% of plan growth rate if higher, and with a reasonable increase in expenses, consistent with the higher growth."

Description:

The adjusted growth rate per year is calculated as:

$$\max(30\%, 150\% \text{ of plan growth rate})$$

where adjusted growth rate can be defined at company, or business line, or product group level, whatever is more appropriate for the company's specific circumstance.

This adjusted growth rate is then applied to sales:

$$\text{Sales}_{t+1} = \text{Sales}_t * (1 + \text{adjusted growth rate per year}) \text{ for } t = 0, 1, 2, 3$$

where t denotes current year or forecast year.

The adjusted growth is to be applied on a yearly basis. First apply to the base scenario assumptions at the start of the projection year and persist throughout the year, then for the remaining years, apply similarly to the adjusted sales. Here is an example:

| | Actual | Forecast period | | |
|---------------------------|--------------|-----------------|--------|--------|
| | Current year | Year 1 | Year 2 | Year 3 |
| Plan sales (in units) | 100 | 110 | 140 | 170 |
| Plan growth rate | | 10.00% | 27.27% | 21.43% |
| 150% plan growth rate | | 15.00% | 40.91% | 32.14% |
| Adjusted growth rate | | 30.00% | 40.91% | 32.14% |
| Adjusted sales (in units) | | 130 | 155 | 185 |

F. Scenario with low growth

Statement:

"Low growth throughout the forecast period, with year 1 sales being 80% of current year, followed by 20% drop for years 2 and 3, without any saving in expenses other than commission and commission-related expenses that are directly related to the new sales volume."

Description:

Adjusted growth rate per year = - 20%

where adjusted growth rate can be defined at company, or business line, or product group level, whatever is more appropriate for the company's specific circumstance.

This adjusted growth rate is then applied to sales:

$Sales_{t+1} = Sales_t * (1 + \text{adjusted growth rate per year})$ for $t = 0, 1, 2, 3$
where t denotes current year or forecast year.

The adjusted growth is to be applied on a yearly basis. First apply to the base scenario assumptions at the start of the projection year and persist throughout the year, then for the remaining years, apply similarly to the adjusted sales. For example, if the actual sales of current year is in 100 units, then the adjusted sales are $(100*80\%)$, $(100*80%*80\%)$, $(100*80%*80%*80\%)$ for year 1, 2 and 3 respectively in the forecast period.

4. Plausible Adverse Scenarios

The Actuary should take note of the application and timing of shocks, as well as potential ripple effects to be considered.

Given that resilience reserves and reserve provisions for Class G Long Term Business determined under GN7 are also established to protect against adverse investment scenarios, the Actuary should consider adjusting projected resilience reserves and GN7 reserves in this scenario, to ensure a proper provision for the same risk.

The Actuary should disclose in a statement whether such reserves adjustments have been made in this scenario. Please note that such adjustments should only be considered for the investment scenarios in this AGN.

Example compound scenarios

The following scenarios are examples only, and may be substituted by alternative compound scenarios that are more relevant to the Insurer.

G. One year short-term shock scenario associated with a pandemic outbreak:

A moderate to severe pandemic should be considered, for example, flu or similar respiratory disorder with high mortality rates across all ages.

- (a) Excess death of 0.75 per thousand at all ages in year 1², but with the same mortality rates as the base scenario in later years;
- (b) Concomitant shocks to equity and real estate markets. 25% drop in equity and real estate in year 1, but with the same growth rates as the base scenario in later years;
- (c) Low growth, with year 1 sales being 80% of current year or 80% of projected plan sales, if lower, but with the same growth rates as the base scenario in later years;

² For comparison, the 1918 flu pandemic resulted in 5.2 excess deaths per 1000 in the USA (vs. 0.4 in 1957 & 0.17 in 1968). The committee settled on a value of 0.75 as being appropriately extreme by historic standards to fit the purpose of the DST

The actuary should also consider possible knock on effects to morbidity rates / health insurance claims, bond yields etc. as well as the possible effects on business continuity due to staff absences (see J. Operational Incidents).

Description:

- Excess death of 0.75 per thousand at all ages in year 1;

The adjusted mortality rate is calculated as:

$$q'_{x+t} = q_{x+t} + 0.00075 \text{ for } t=1;$$

$$q'_{x+t} = q_{x+t} \text{ for all } t>1$$

where q'_{x+t} is the adjusted mortality rate, q_{x+t} is the original mortality rate, with x denoting the issue age and t denoting the policy year. For example, a mortality rate of 0.001 may become $(0.001+0.00075=0.00175)$ for year 1 only and then revert to the normal pattern for the rest of the years in the forecast period.

- Concomitant shocks to equity and real estate markets. 25% drop in equity and real estate in year 1;
A 25% drop in equity and real estate in year 1, but with the same growth rates as the base scenario in later years. Projected equity and real estate values are calculated in the same way as described in the simple “Scenario with rise of interest rates”.
- Low growth, with year 1 sales being 80% of current year or 80% of projected plan sales, if lower;
Sales in year 1 should be 80% of current year or 80% of projected plan sales, if lower, such that
Year 1 sales = current sales * (1 – 20%)
Sales in later years of the forecast period would follow the plan growth rate.

H. Medium-term inflationary scenario:

- (a) Interest rates (new money yield) 4% p.a. higher than base assumptions throughout the forecast period, commencing immediately after the valuation date;
- (b) Inflation 4% p.a. higher than base assumptions throughout the forecast period, commencing immediately after the valuation date;
- (c) Non-guaranteed element such as dividend rates may be forced up in the light of the emerging investment return;
- (d) Switch all or a specific portion of new sales to products that reflect the increased new money rates better than the traditional products, or alternatively, if no new products being assumed, a reduced level of new sales should be assumed instead;
- (e) 25% drop in equity and real estate market values in the first two years, with base scenario growth rate on these asset values in the remaining forecast period.

Description:

- “Interest rates (new money yield) 4% p.a. higher than base assumptions throughout the forecast period, commencing immediately after the valuation date”;

The adjusted interest rate is calculated as:

$$i'_t = i_t + 4\% \text{ for all } t \geq 0$$

where i'_t is the adjusted interest rate, i_t is the original interest rate, with t denoting projection year. The adjusted interest rates are to be applied to the base scenario assumptions immediately after the start of the forecast period, and continue to apply on a yearly basis throughout the forecast period. For example, a 5% interest rate may become (5%+4%=9%).

- “Inflation 4% p.a. higher than base assumptions throughout the forecast period, commencing immediately after the valuation date”;

The adjusted inflation rate is calculated as:

$$r'_t = r_t + 4\% \text{ for all } t \geq 0$$

where r'_t is the adjusted inflation rate, r_t is the original inflation rate, with t denoting projection year. The adjusted inflation rates are to be applied to the base scenario assumptions immediately after the start of the forecast period, and continue to apply on a yearly basis throughout the forecast period. For example, a 3% inflation rate may become (3%+4%=7%) throughout the forecast period.

- “25% drop in equity and real estate market values in the first two years, with base scenario growth rate on these asset values in the remaining forecast period”.

The deterioration of equity and real estate value may be assumed to occur sometime during the first 2 projection years, and subject to growth (if any) for the remaining forecast period. For example, if the original equity and real estate value is in 100 units, and the growth rate in the base scenario is 10% throughout the forecast projection period, then the adverse equity and real estate value is (100*75%) by the end of year 2, and recover to (100*75%*110%) in year 3 and similarly in remaining years of the forecast period.

The equity and real estate value should be consistent with the accounting basis of the Insurer for assets, such as reported on marked-to-market basis or book value. This is to test the matching between assets and liabilities under different interest sensitivities.

I. Medium-term deflationary scenario:

- (a) Short-term interest rates of new money yield drop by 50% in total over the course of the first 3 years in the forecast period;
- (b) Inflation rate decreases to base scenario rate less 4% for every year in the forecast period;
- (c) Non-guaranteed elements such as dividend rates may go down consistently in the light of the emerging investment return;
- (d) 25% drop in equity and real estate in total over the first 2 years, then remain stable in year 3 and thereafter;
- (e) Bond default rates to double (over those assumed in the base scenario);
- (f) Prepayments of mortgages are doubled.
- (g) 10% deterioration in foreign exchange rates in year 1, on the currencies unmatched portion of assets or liabilities, and then the foreign exchange rates remain unchanged in the later years.

Description:

- “Short-term interest rates of new money yield drop by 50% in total over the course of the first 3 years in the forecast period”;
The change in short-term interest rates may be assumed to occur sometime during the first 2 projection years. For example, if the original short-term interest rate is 5%, it may drop to (5% * 50%) by the end of year 2, then remain stable in year 3 and thereafter.
- “Inflation rate decreases to base scenario rate less 4% for every year in the forecast period”;
The adjusted inflation rate is calculated as:
$$r'_t = r_t - 4\% \text{ for all } t \geq 0$$
where r'_t is the adjusted inflation rate, r_t is the original inflation rate, with t denoting projection year. The adjusted inflation rate is to be applied to the base scenario assumptions immediately after the start of the forecast period, and continue to apply on a yearly basis throughout the forecast period. For example, a 3% inflation rate may become (3% - 4% = -1%).
- “25% drop in equity and real estate in total over the first 2 years, then remain stable in year 3 and thereafter”;
For example, if the original equity and real estate value is in 100, it may drop to (100 * 75%) by the end of year 2, then remain stable in year 3 and thereafter;
- For the unmatched currencies portion of assets and liabilities, a 10% deterioration would be either a 10% depreciation in the unmatched portion of assets or a 10% appreciation in the unmatched portion of liabilities, including the unmatched portion on pegged currencies. Any impact from the derivatives on currency and any possible future depreciation on the unpegged currencies should also be taken into account.

Additional plausible adverse scenarios

The Actuary should consider testing additional plausible adverse scenarios where plausible adverse assumptions about matters to which the Insurer's financial condition is sensitive. The Actuary should consider the following scenarios where applicable.

J. Operational Incidents

The Actuary should consider the resilience of the business to operational incidents, particularly for classes of business which have a relatively low minimum solvency requirement under the ICO, in particular Class C linked business.

Moderate operational error scenario:

A moderate operational event which may result from mis-selling and/or operational failures should be considered. This kind of event will have an adverse impact on the insurer's reputation, causing a reduction in new sales as well as lapsation from the current in-force book.

Apart from the potential regulatory fine or compensation to policyholders, some companies may incur extra expenses in marketing to compensate for the reduction in new business. The effect of a moderate operational incident is expected to persist for around 2 years in the minds of customers.

- (a) For all new business across all classes, new business sales reduced by 30% compared to the base projection for two years;
- (b) Increased lapsation of in-force policies, with an absolute addition of 10% to lapse rates for 2 years (i.e. a 5% lapse rate would increase to 15%).
- (c) A regulatory fine of HKD\$5,000,000, which is equal to half the cap for regulatory fines specified under CAP 41C (Source: Section 81.4.e.i)
- (d) A relative increase in acquisition expenses of 20% for 2 years, which reflects the increased marketing expense to acquire new business.

In addition to the above, for insurers with Class C business in force, an operational incident scenario must be performed with a minimum aggregate loss equal to 1% of the Class C funds under management (before any discounting that might be applied to the mathematical reserve). This scenario may incorporate elements from the above and/or operational errors such as incorrect unit pricing and investment allocation errors which may lead to losses as a result of the need to make compensation payments to policyholders.

K. Counterparty Default Events

The Actuary should consider the resilience of the business to counterparty default events. An example would be an economic recession triggering defaults of major corporate bond issuers, reinsurers and derivative counterparties.

Some guidance and considerations that the Actuary may consider for bond defaults include:

- (a) The Actuary may consider the impact of defaults on the company's fixed income portfolio equivalent to 0.5% of the market value of its investment grade bonds (excluding AAA rated corporate bonds and highly rated sovereign bonds) and 3% of the market value of its non-investment grade bonds³, or default on the largest bond issuer of the company's fixed income portfolio (excluding AAA rated corporate bonds and highly rated sovereign bonds), whichever impact is higher.
- (b) These bond default events typically occur during economic downturn, where there will be widening of corporate bond spreads as well. The Actuary may consider the impact of a widening of 50bps for its investment grade bonds and 100bps for its non-investment grade bonds. Where appropriate the Actuary should also consider testing the compound impacts of other asset price shocks (e.g. equities and other derivatives) to the entire portfolio of the business.
- (c) When a bond defaults, one can expect a portion of the principal and accrued interest can be recovered. The Actuary should apply judgment on the assumed recovery rate, but typically it should not be greater than 50%⁴ if the event is assumed to happen as a result of an economic recession.

With regard to reinsurer defaults the Actuary may consider to test on a separate scenario:

- a) Testing the impact of the default of its most significant reinsurer in terms of business ceded.
- b) Any collateralization or other guarantee mechanisms provided by the reinsurer under specific reinsurance agreements.

Other notes on the Scenarios

As a minimum the Actuary should test the six prescribed simple scenarios and at least three compound scenarios. In addition the Actuary should consider whether the additional plausible adverse scenarios should be included in the investigation (such as those shown above or others more relevant to the Insurer). For insurers with Class C business in force,

³ These suggested parameters were set with reference to historical default rate information from the 2014 Standard & Poor's Annual Global Corporate Default Study, with certain level of prudence considered.

⁴ Moody's Sovereign Default and Recovery Rates, 1983-2010 gives a range of 18% - 95%, depending on the default incident and metric used, with a value weighted average around 35%

scenario J listed above should be included. The Actuary should determine the sensitivity of the Insurer's capital adequacy to each risk. These scenarios should be tested independently and reported on an annual basis.

To help the Actuary determine if a risk is material and plausible, it may be useful to stress test the capital adequacy of the Insurer. The Actuary might determine how much a base scenario assumption needs to be changed before an adverse scenario gives rise to an unsatisfactory financial condition. The Actuary can then judge whether a plausible risk or event exists for the Insurer over the forecast period.

In many cases, plausible adverse scenarios are associated with a low probability of occurrence but the potential financial impact could be severe. In such cases, it is usually not necessary for the Actuary to construct integrated scenarios by combining two or more low probability adverse scenarios.

In some cases, however, the probability associated with a plausible adverse scenario may be close to the probability associated with the base scenario. For example, a significant asset on the balance sheet may be showing early signs of distress. In such cases, an integrated scenario would be constructed by combining each more probable adverse scenario, with a low probability adverse scenario. The low probability adverse scenario selected would be the one that has the greatest effect on the Insurer's financial condition and is plausible when combined with the more probable adverse scenario.

The resulting plausible scenarios would be expected to have a financial outcome more adverse than the worst prescribed scenarios. Where the actuary has chosen plausible scenarios which have a financial result less adverse than the prescribed scenarios the actuary should explicitly state that, in the Actuary's opinion, no plausible scenario has an outcome which is more financially adverse than the worst prescribed scenario. In this case the actuary should also present the results of the capital adequacy "stress testing" described above.

5. Ripple Effects

Ripple effects include both regulatory action and policyholder behaviour especially under any plausible adverse scenario where the Insurer fails to meet the minimum regulatory capital requirement. In considering plausible risks and ripple effects, the Actuary needs to determine the best estimate assumptions. Below are some guidelines for some of the possible assumptions to take note of:

5.1 Assumed capital enhancements

There will be some situations where capital enhancements are a basic part of an Insurer's business plan. This should not be a cause for the Actuary to not be able to sign the satisfactory opinion. However, the Actuary should be satisfied with the intent of the entity making the injection, and that such injections are within the means of that entity. The Actuary should clearly report the projected future capital injections in the base scenario.

For testing adverse scenarios essentially out of the control of management, it is appropriate then not to assume any additional capital from outside, beyond that called for in the business plan and base scenario. If the satisfactory financial position in a test relies on additional capital being available to the company over and above what is assumed in the business plan, this should be stated and has it communicated explicitly in the report to the Board of Directors.

5.2 Assumed management action

As part of projecting future financial positions, the Insurer's expected response to adversity can be taken into account. Selection of the assumptions for each response should at least take into consideration the following items:

- the effectiveness of the Insurer's management information systems;
- the Insurer's historical record of promptness and willingness to make difficult decisions, when faced with adversity; and
- the external environment assumed in the scenario.

In accordance with the standard of practice and in order not to present a misleading picture, clear reporting of assumed management action is essential. The Actuary should report the assumed response, so that users of the report may consider its practicality and adequacy. Also, for each of the plausible adverse scenarios posing the greatest risk, the Actuary should also report the results without the effect of extraordinary management action.

In this context, *extraordinary management action* refers to those actions which would occur relatively rarely, such as

- raising additional capital above what is assumed in the business plan,
- placing a limit on the volume of policies issued, or
- reducing dividends for products which have never had dividend cuts in the past.

5.3 Assumed regulatory action

There may be some situations where regulatory response to adverse scenarios should be assumed to occur. The Actuary should consider the impact of the regulator in restricting new business or even taking control. In cases where the regulator takes control, the Actuary should assume that all assets and liabilities would be re-evaluated on a liquidation basis.

For such situations the Actuary should report results with and without the assumed regulatory action.

The Actuary should not assume a change in Actuarial standards or regulations, unless it is more prudent to do so.

5.4 Assumed rating agency action

Many plausible adverse scenarios will result in a significant reduction of capital and surplus. In cases where a downgrade by a rating agency is likely, the Actuary should incorporate the consequences of the downgrade into the scenario.

It may be helpful under adverse scenarios to report results with and without assumed rating agency action.

5.5 Assumed policyholder behaviour

Under certain adverse situations, the insurer may suffer losses due to policyholder behaviour. In particular, in high interest rate scenarios, products with high guaranteed cash values, e.g. universal life products, are more likely to experience higher policyholder disintermediation. This may be due to a variety of reasons e.g.

- the adverse effect of higher interest rates on variable rate mortgages and loans,
- unemployment due to poor economic conditions,
- the desire to seek higher returns elsewhere.

This situation may be exacerbated by the fact that in some cases the cash used to purchase the insurance product has been acquired through premium financing. The losses that the insurer may suffer as a result of the above should be considered within the projections.

For products that have a material savings element, it is common to model an add-on to the rate of lapsation which is a function of market interest rates less the rate of return to policyholders expected under the contract.

It may be helpful under adverse scenarios to report results with and without assumed policyholder behaviour.

6. Revaluation of the Assets

In case where asset modeling is not available for projecting individual assets, the Actuary can choose to apply the adjustment factors to each invested asset whose value depends on interest rates. Each adjustment factor should have its determination approach / rationale fully described and its reasonableness tested by the Actuary. Financial instruments whose values depend on other market factors should be similarly revalued throughout the forecast period, in accordance with changes in those factors in each scenario.

7. Sample Report Outline

The Actuary should deliver a clear and complete report on the results and implications of the work. A sample report outline is given in Appendix 1.

APPENDIX 1: Sample Report Outline

- (a) Executive Summary
 - Summarization of scenario results
 - Highlight the most significant capital adequacy risks
- (b) The Actuary's Opinion Statement
- (c) Introduction to Dynamic Solvency Testing Report
 - Purpose of the report
 - Scope, process, limitations and reliance
 - Methodology – projection software used, description of projection model used
 - Revaluation of the Assets / Policy Liabilities – in case of any limitation on assets / policy liabilities modeling, description of any approximation being adopted, with the approach / rationale and reasonableness.
- (d) Capital Adequacy Measurement
 - Description and current position
- (e) Base Scenario
 - Description of scenario, assumptions and results
 - Discuss consistency of the capital position with the situation projected in the previous year's base scenario.
- (f) Six Prescribed Scenarios
 - Description of scenarios, assumptions and results
 - Disclosure as to whether any adjustment has been applied to resilience reserves or GN7 reserves under the investment scenarios of this AGN
- (g) Three Compound Adverse Scenarios
 - Description of scenarios, assumptions and results
 - Disclosure as to whether any adjustment has been applied to resilience reserves or GN7 reserves under the investment scenarios of this AGN
- (h) Two Additional Plausible Adverse Scenarios
 - Description of scenarios, assumptions and results
 - Disclosure as to whether any adjustment has been applied to resilience reserves or GN7 reserves under the investment scenarios of this AGN
- (i) Analysis of Risks by Line of Business
 - Discussion of risks and scenario results
- (j) Conclusions and Recommendations
 - Summary of results
 - Actuary's assessment and recommendations, including the ability of the Insurer to meet satisfactory financial condition
 - Risks that threaten the financial strength of the Insurer

(k) Appendices

- Capital enhancement activities
- Key assumptions, under which references should be made to experience reports or investigations produced and utilized in preparing projections. These normally include: economic assumptions; mortality / morbidity; lapse rates; expenses; reinsurance; other material assumption(s), if any.
- Other considerations (e.g. rating agencies, taxation, valuation/accounting issues)

APPENDIX 2– List of Considerations

The list below outlines a number of items that can be considered when constructing a scenario or determining ripple effects. This list is by no means exhaustive, and should not be relied upon by the Actuary as being the only items that need to be considered when constructing a scenario.

- Mortality rates (allowing for changes in underwriting practices)
- Morbidity and other claim incidence/recovery rates (allowing for changes in underwriting and claims management practices)
- Initial expenses
- Renewal expenses
- Investment expenses
- Expense inflation
- Commission overrides / commission related expenses
- Lapse rates
- Surrender/redemption rates
- Partial surrender/fund withdrawal rates
- Unit linked growth rates / Universal Life crediting rates
- Premium holiday rates
- Non-forfeiture option take-up rates (e.g. policy loans)
- Other non-forfeiture option assumptions (e.g. Policy loan interest rates)
- Reinsurance premiums, recoveries, commissions, profit shares etc., and the potential impact of reinsurance reviews to them in the future
- Possibility and severity of potential reinsurer defaults
- New business product mix
- New business sales
- Changes in premium mode
- Changes to non-guaranteed premium rates
- Changes to other non-guaranteed product features
- Changes to investment management fees charges
- Bonus/Dividend scales, and changes to them in the future
- Take-up and surrender rates for dividend left on deposit
- Crediting rates for dividends left on deposit
- Take-up rates for dividends settled as paid-up additions
- Take-up of other options granted to policyholders (e.g. annuity settlement options etc.)
- Capital inflows / shareholders dividends paid from/to parent company (allowing for changes in target surplus requirements for each scenario)
- Capital injections into subsidiary Life Co
- Tax rates and tax losses carried forward
- Asset purchases / sales in the future, allowing for liquidity requirements
- Accounting basis that is adopted for asset valuation on the balance sheet
- Investment policy and implications of any shock to it
- Changes in corporate bond credit spreads and default rates in each scenario
- Options and guarantees embedded in assets (e.g. callable bonds)
- Re-pricing of new business after a shock
- Methods and assumptions used in determining liabilities in each scenario

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- Changes in the severity of the currency mismatch and resilience reserve tests assumed to apply in the scenarios
 - Changes in the foreign exchange rates
 - Credit rating for the Company (e.g. a down-grade could affect sales and surrenders)
 - Differences in policyholder behaviour by issue year cohorts or by other policyholder segments
 - Operational incidents
 - Counterparty default events

***** END OF ACTUARIAL GUIDANCE NOTE *****

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