30 November 2018

2018 CAPITAL AND SOLVENCY RETURN

STRESS/SCENARIO ANALYSIS – CLASS 3A

The Bermuda Monetary Authority (the Authority) requires Class 3A insurers[1] to conduct prescribed stress/scenario testing and analysis. The results are to be submitted to the Authority as part of the 2018 year-end Capital and Solvency Return.

The objective of stress testing within the 2018 year-end Capital and Solvency Return is to assess the capital adequacy of the insurers under adverse financial market and underwriting conditions and provides a comprehensive understanding of the sector's general vulnerability to shocks. More specifically, the purpose of the tests is to assess the impact of the losses, as determined using proprietary/vendor models, on the insurer's statutory balance sheet (i.e. statutory admitted assets, admitted liabilities, and capital and surplus). Thus, these tests help determine the financial capacity of insurer to absorb the manifestation of key financial risks, such as shocks to investment performance and projected losses arising from specific underwriting risks.

GENERAL INSTRUCTIONS

Measurement of impact: As noted above, the insurer is to provide the post stress/scenario positions of the expected impact and effects on both statutory assets and liabilities.

Accounting treatment: The insurer is to use the accounting standard ordinarily used for statutory reporting so that the pre-stress/scenario statutory capital and surplus can be reconciled to the insurer's 2018 year-end statutory balance sheet.

Timing of impact: The stress/scenario impact and effects reported are those that would be observed immediately upon the occurrence of the event (stress/scenario) as determined by the insurer's internal or vendor model(s) (both with and without the effect of reinsurance and/or other loss mitigation instruments).

Balance sheet date: The insurer is to run the stress/scenario tests based on its balance sheet position and aggregate in-force exposures as at 1st January 2019[2].

Reporting currency: All amounts reported with respect to the stress scenarios must be shown in the

[1] In this document, the terms "insurer" and "insurer's" include "reinsurer" and "reinsurer's", respectively.

[2] Where the fiscal year does not correspond to the calendar year, in-force exposures on the day following the fiscal year-end should be used rather than 1st January 2019.

Bermuda equivalent. In this regard, the Bermuda equivalent of an amount in foreign currency is an amount converted into Bermudian dollars at the rate of exchange used by any licensed bank in Bermuda in relation to purchases by that bank of that foreign currency on 1 January 2019 or the day after, provided that the rate of exchange of one US dollar will be deemed to be one Bermuda dollar.

Vendor and/or internal model descriptions: To assist the Authority with comparability, the insurer is to provide a description of the vendor model(s) used to perform the stress/scenario tests, identifying what model and version was used for each stress/scenario. The acquisition of a vendor package is not an obligation. Where an internal model is utilised, the description should also include information on the internal model's key assumptions and parameters.

Confirmation of no loss exposure: For instances where the insurer has no loss exposure to a particular financial market scenario(s), underwriting loss scenario(s) and/or has no Other Underwriting Loss Scenarios, the Authority has created a new section that allows for the confirmation that fields left blank/omitted are the result of no loss exposure.

A. FINANCIAL MARKET SCENARIOS

The financial market scenarios comprise capital market-related single factor shocks triggered by specific risk factors (equity returns, credit spreads and defaults). The calibration of these shocks is based on historical data about the evolution of interest rates, exchange rates and equity markets. Further, in light of continued sovereign risk concerns and its implications on the investment performance of insurers, the financial market scenarios include haircuts on sovereign bonds. The ongoing volatility due to political risk and also volatility of capital flows warrants shocks on foreign currency positions.

The insurer is to quantify the impact of the following stress events on its statutory balance sheet:

Stress Event	Interpretation
R1. Severe decline in equity prices	The stress test is a decrease of 40% of the value of equities in a portfolio. This stress scenario is consistent with the Black Monday crash of 1987. If there are hedging instruments for equity exposures, their hedging result should be recorded separately. If hedging is done through replication strategies or continuous rollover of assets, this should be mentioned in the stress test result. Short positions are considered hedging positions. Material equity derivative positions should also be included in the test.
R2. Alternative Investments and Real Estate	This stress is related to investment holdings in hedge funds, ILSs, real estate, private placements, venture capital and other types of securities that cannot be characterised as equity, bonds, cash, foreign exchange and mutual funds in typical asset categories or participations to other corporations excluding venture capital. Usual characteristics of these assets are the low correlation with financial markets and the low or lower liquidity compared with typical financial assets. Such assets should be decreased in value by 40%. For assets such as hedge funds with lockup periods, venture capital and real estate in illiquid markets, the (re)insurer should report whether sudden decreases in their value could entail inability for rapid sale and whether this effect has material

consequences.

Level 3 Assets A shock of a 40.0% reduction in the value of level 3 assets should be performed. If level three assets can be found in alternative investments and real estate, equities or other categories, then those assets have to be reported and stressed separately.

R3. Extreme US Yield Curve Widening

This stress refers to an extreme movement upwards of the U.S. yield curve. The (re)insurer will use the following risk-free yield curve for valuations of assets and liabilities. Corporates should be revalued as well assuming constant credit spreads. For assets and liabilities with durations longer than 30 years, assume a constant rate of 5.0% from year 31.

Table 1 – Yield Curve (In Percent)

Year	1	2	3	4	5	6	7	8	9	10
	4.13	4.40	4.61	4.65	4.81	4.87	4.87	4.87	4.86	4.85
Year	11	12	13	14	15	16	17	18	19	20
	4.83	4.84	4.83	4.82	4.82	4.82	4.82	4.82	4.82	4.82
Year	21	22	23	24	25	26	27	28	29	30
	4.82	4.82	4.82	4.83	4.82	4.83	4.83	4.84	4.84	4.84

Source: BMA staff calculations and Bloomberg. Notes: This yield curve is a product of a bespoke BMA scenario generator. This yield curve represents the 99th percentile yield curve of all simulated paths of interest rates for each maturity.

R4. General widening of credit spreads

Credit spreads widen across different rating classes (See Table 2). The widening reflects the increase of the perceived credit risk in the market. The table summarizes the shocks.

Table 2. Credit Spread Widening
In basis points

Rating Category					
AAA	**AA**	**A**	**BBB**	**BB**	**Below BB**
102.0	150.0	145.0	156.0	410.0	4,231.0

Source: BMA staff calculations and Bloomberg. Notes: The 99.9th percentile was used for all but two scenarios. For AAA we used the 99th percentile, for junk bonds (ratings Below BB) we used the 99.99th percentile. The spreads in these rating classes show high (for AAA) or low (for Below BB) variability compared to the intermediate rating classes. The 99th percentile would overestimate the reasonable stress scenario for AAA assets and it would underestimate a reasonable stress scenario for Below BB. We used the Moody's bond indices for ratings from AAA to BBB and the J. P. Morgan bond indices for BB and Below BB rating classes. The reference risk free rate was the 10-year U.S. treasury rate.

All positions including available for sale and held to maturity should be stressed. Structured finance products, asset-backed securities, agency and non-agency MBSs must be included as well. If there is no rating for an asset, the (re)insurer must assume that the rating is Below BB. CAT Bonds are treated as alternative investments and not as assets susceptible to credit spread changes.

R5. Combine R1, R2, R3 & R4

R6. Foreign currency shocks

An equal percentage of depreciation and/or appreciation of foreign exchange positions in both assets and liabilities when these shocks reduce the value of assets and increase the value of liabilities. When an FX liability is passed on the party claiming the liability, the shock can be excluded for such positions. The following table provides the percentage depreciations/appreciations. Hedging of FX positions should be reported separately, especially if hedging

is done with roll-over strategies.

Table 3. Exchange Rate Shocks (*In percent)*

	EUR/USD	JPY/USD	GBP/USD	CHF/USD	AUDUSD	*Avg.*
Shock	19.3	23.9	35.7	22.9	27.8	25.9

Source: BMA staff calculations and Bloomberg. Notes: For currencies other than those indicated the average appreciation/depreciation (rightmost column) should be used. The scenario estimation horizon covers daily exchange rate movements from 2000 up to 2017. A GARCH (1,1) model was used to generate the scenarios. Due to Brexit the GBP/USD shock increased by considering the 99.9th percentile of projected depreciation.

R7. Escalation of Sovereign risk

In this test we assume that the weakest sovereigns will have to undergo a haircut in the face value of their debt. Both available for sale and held to maturity bonds should be stressed.

Table 4. Reductions in Current Value of Sovereign Bonds

	Time to Maturity				
Country	**<1 year**	**<3 years**	**<5 years**	**<7 years**	**>7 years**
Greece	100.0	100.0	100.0	100.0	100.0
Ireland	50.0	50.0	50.0	50.0	50.0
Italy	50.0	50.0	50.0	50.0	50.0
Portugal	50.0	50.0	50.0	50.0	50.0
Spain	50.0	50.0	50.0	50.0	50.0
Ukraine	100.0	100.0	100.0	100.0	100.0
Argentina	50.0	50.0	50.0	50.0	50.0

Source: BMA staff calculations and Bloomberg. The haircuts are based on the realization of a prolonged pan-European banking crisis in Europe which will cause sovereign defaults.

(Re)insurers should report positions with Greek, Russian and Ukrainian counterparties of material nature. Such counterparties can include policyholders, (re)insurers, SPIs etc.

R8. Inflation and Monetary Policy Risk

Inflation risk stems from the general increase of prices. Inflation decreases the value of loans and debts while it may increase the value of indemnities and claims.

Simulate a scenario similar to the 1973 inflationary scenario. The (re)insurer should apply each inflation scenario (low, medium, high, severe) for three years assuming no initial action to curb inflation from the Federal Reserve. In year four the Federal Reserve changes stance and increases rates to maintain the current real interest rate. Therefore the reinsurer should raise the yield curve across maturities for one year by 510, 730 and 1,130 basis points respectively for the medium, high and severe inflation scenario. From year five and onwards inflation and interest rates return to current levels. All assets and liabilities are to be shocked. In case that the (re)insurer holds TIPS or other inflation sensitive securities, these securities should be indexed to the inflation scenarios.

Table 5: Inflation Scenarios (In percent)

Scenario	Inflation Rate
Low Inflation	2.7
Medium Inflation	5.1

High Inflation	7.3
Severe Inflation	11.3

Source: BMA staff calculations and Federal Reserve of Saint Louis. Each inflation scenario corresponds to the 50th, 80th, 90th and 99th percentile of the historical annual U.S. core inflation rates from 1957 until 2016.

B. MORTGAGE INSURANCE

The insurer is to quantify the impact of the following stress events on its statutory balance sheet:

Mortgage Loan Shock 1	Part 1 - (Re)insurers that write mortgage business are to shock their exposure for this business by increasing the default rate to 9.47% (equivalent to approximately 99.5% TVaR) for their mortgage book and applied instantaneously. Assets and liabilities subject to mortgage-related default risk should be shocked. Part 2 - (Re)insurers holding agency MBS and real-estate securities as investment assets subject to prepayment risk are to shock these investments by assuming that the MBS will prepay at an annual constant prepayment rate (CPR) of 40% instantaneously. If the 40% CPR produces capital gains, the insurer is to stress the CPR at 0%, 5% and 10%. The expectation is that if using a CPR of 40% produces a gain, then applying a substantially lower MBS prepayment shock rate of 10% or less will likely produce capital losses. If a registrant still reports capital gains even after applying the lower MBS prepayment rates, then the registrant should provide sufficient comments.
Mortgage Loan Shock 2	Part 1 - (Re)insurers that write mortgage business are to shock their exposure for this business by assuming the default rate to be 5.5% (equivalent to approximately 90.0% TVaR) for their mortgage book and applied instantaneously. Assets and liabilities subject to mortgage-related default risk should be shocked. Part 2 - (Re)insurers holding agency MBS and real-estate securities as investment assets subject to prepayment risk are to shock these investments by assuming that the MBS will prepay at an annual constant prepayment rate (CPR) of 40% instantaneously. If the 40% CPR produces capital gains, the insurer is to stress the CPR at 0%, 5% and 10%. The expectation is that if using a CPR of 40% produces a gain, then applying a substantially lower MBS prepayment shock rate of 10% or less will likely produce capital losses. If a registrant still reports capital gains even after applying the lower MBS prepayment rates, then the registrant should provide sufficient comments.

C. UNDERWRITING SCENARIOS

The insurer is to submit to the Authority three of its own underwriting loss scenarios and also use these in the calculation under Section V1 below. The insurer is to submit the following for each of the three scenarios:

a. Description of the scenarios and related key assumptions; and
b. The post stress/scenario positions on aggregate statutory assets and statutory liabilities that would be observed immediately upon the occurrence of the event (stress/scenario) (both with and without the effect of reinsurance and/or other loss mitigation instruments).

Return Periods (Only for Class 3A insurers that write Property Catastrophe business):

a. Occurrence return period of each event (e.g. 1-in-50 year event, 1-in-100 year event, etc.) i.e. the likelihood of an event occurring in a given year; and
b. Relative return period (or "aggregate return period") i.e. use the underlying loss distribution of the aggregate Net Probable Maximum Loss (as submitted in the Bermuda Solvency Capital Requirement (BSCR) Risk Management Schedule V item (h) for Class 3A insurers) to calculate the corresponding return period (e.g. 1-in-50 year event, 1-in-100 year event, etc.) of each event.

Example - the return period for a loss event of $78 billion industry loss event may occur once every 300 years (i.e. occurrence basis). The stress scenarios are specifically selected to be extreme events that have a low probability of occurring. For the occurrence return period, the Authority is seeking a comparison to how the insurer's losses under the stress scenarios compare to the insurers loss for the overall peril. For this relationship, looking at the insurer's stressed loss compared to the insurer's OEP curve for the event is the most helpful. Modeled events are selected based on the definitions below. This may be a single event from the catalog, or may be a small subset of events. The losses from these events are then simulated based on the exposures of the insurer. This will produce an expected loss cost to the insurer under the stress scenario. This $400m loss is compared to the insurers OEP curve for all events and is found to be at the 98th percentile. The occurrence return period would be given as 1-in-50 years.

For the aggregate return period (AEP[3]) the Authority is trying to assess how the insurers' losses in a stress scenario will compare to the overall AEP curve of the company. The AEP curve used should be the same curve used to inform the calculation of the net probable maximum loss and reported in the Cat Return of the BSCR. For this same event, comparing the $400m loss to the insurers' net AEP curve for all perils combined would be at the 92nd percentile. This would be reported as a relative return period of 1-in-12.5 years.

For the occurrence return period (OEP[4]) the net loss impact of the stress scenario modeled using the selected events should be compared to the insurers' net OEP curve for the specified peril using all events. For the Relative return period the net loss impact of the stress scenario modeled using the selected events for a specific peril should be compared to the insurers' overall net AEP curve that was used to inform the net Probable Maximum Loss and reported in the catastrophe returns in the BSCR.

The insurer is to include demand surge and storm surge for storm events, and demand surge and fire following for earthquakes. All lines of business and exposures should be included in the final estimates;

[3] The AEP represents the probability of seeing total annual losses of a particular amount or greater

[4] The OEP represents the probability of seeing any single event within a defined period (one year in this case) with a particular loss size or greater.

any deviations from this requirement should be noted.

D. LIABILITY LOSS ACCUMULATION SCENARIOS

The insurer/group is to complete the following scenarios which estimate potential insurance loss accumulations relating to liability exposures. The scenarios aim to capture risk on liability exposures that are generally not adequately reflected by historical claims experience. Such risks tend to materialize slowly and impact many exposure years.

a) Scenario 1 - New latent liability

The scenario aims to cover a "mass tort" event , for example following a court decision, a general and potentially legally enforceable opinion emerges that a specific product or substance causes observed or potential future adverse effects such as bodily injury, property damage or environmental damage. This is expected to lead, during the year and later, to claims on the product liability insurance of the producers, followed by mass litigation against companies that are distributing or using or have distributed or used the product or substance, leading to an accumulation of potentially worldwide claims on general commercial liability and workers compensation/employers liability insurance policies. Losses do not only arise from the current policy year but also prior years not excluded by policy terms such as "claims made" coverage or statutes of limitations. The scenario takes into consideration that the amount recognised at the end of the one-year time horizon is smaller than the maximum possible ultimate loss from the scenario, due to incompleteness of available information and uncertainty on the subsequent development.

The exposure measure for the scenario is the Net Written Premium for the most recent underwriting year onto which the following risk factors are applied.

Selected Factors	product liability	product liability	gen comm liability	gen comm liability	empl liab/ workers comp	empl liab/ workers comp
	P	NP	P	NP	P	NP
EEA and Switzerland	45%	90%	25%	50%	25%	50%
US/Canada	65%	130%	35%	75%	15%	30%
Japan	35%	65%	20%	35%	20%	35%
China	25%	50%	15%	30%	15%	30%
Other developed markets	30%	60%	15%	35%	15%	35%
Emerging markets	25%	50%	15%	30%	15%	30%

The Risk Factors are calibrated based on a 1-in-200 year market loss event which assumes to affect the eight most recent policy years for all latent liability segments with the exception of the line of business employers' liability/workers compensation and the region "USA and Canada", for which it is three years, reflecting local statutes of limitations.

An adjustment is made to the loss calculation by applying a historical premium adjustment factor to reflect material changes in exposures across the impacted policy years. This is approximated using the following two inputs

1. average annual growth in Net Written Premium over the years affected
2. and specifying the years over which the annual growth is affected.

The approximation assumes a constant growth factor year on year. Insurers whose main business is not writing 'live' business (e.g. active runoff insurers) therefore do not have material Premium/Cat Risk do not need to calculate this scenario.

b) **Scenario 2 - Deterioration in existing US A&E reserves**

The scenario aims to reflect potential deterioration in existing US Asbestos and Environmental reserves and is calculated over a number of steps:

1. Potential underserving in US Asbestos and Environmental reserves – In their review of the US market Asbestos & Environmental reserves, Fitch has identified potential underserving in the industry for both risks. Particularly, the market is materially below Fitch's benchmark survival ratio range of 11x to 14x for Asbestos and 8x to 10x for Environmental. Step one uses the insurer's own survival ratios and uplifts their latest year-end reserves to Fitch's upper end of their range. The information required are as follows:-
    a. Insurer's own survival ratio for their latest year-end net GAAP reserves
    b. Net GAAP reserves for US Asbestos and US Environmental for the three most recent yearends
    c. Net Paid over the last three years for US Asbestos and US Environmental and relating only to reserves/exposures present on the insurer's books at the beginning of the year[5]. Material commutations should also be excluded from the paid in order to prevent distortions which would be 'washed away' in the industry statistics.
2. Increase in projected claims inflation for US Asbestos and Environmental reserves – Assume an additive increase of 3% in the annual inflation applicable to all future claim payments. There are several potential sources of this increase including increase in the base indices, superimposed inflation, court inflation and others. The following information is required:
    a. Latest year-end net GAAP reserves recalculated assuming an additive increase of 3% in the annual inflation applicable to all future claim payments for US Asbestos and US Environmental
    b. Effective Duration of US Asbestos and US Environmental Liabilities.
3. Converting to one year loss – Insurers should provide an appropriate emergence factor in order to convert the stress loss from ultimate view to one year view. The following information is required:-
    a. Ultimate to One-year emergence factor

    Insurers with immaterial US A&E environmental reserves do not need to calculate this scenario.

c) **Scenario 3 – Insurer specific A&E reserve deterioration scenario**

Insurers with material A&E reserves should develop their own loss scenario(s) and include it in the 'Other Underwriting Loss Scenarios' section. The assumptions underlying the scenario should also be attached.

E. RATING DOWNGRADE

The insurer is to submit detailed qualitative disclosure of the impact upon both its statutory statement of income and liquidity positions of a ratings downgrade of its Bermuda legal entity by two notches or below A-, whichever is lower. The disclosure should cover and provide an indication of the relative impact/severity of collateral requirements, loss payment triggers on in-force policy contracts, claw-backs, and/or other adverse financial and liquidity implications of the downgrade.

Upon reviewing the disclosure, the Authority may request additional information relating to the liquidity impact and potential losses.

F. WORST-CASE ANNUAL AGGREGATE CATASTROPHE LOSS SCENARIO

[5] This ensures that the payments are 'matched' to the opening reserves.

The insurer is to submit the following:

1. A combination of a financial market scenario and three largest underwriting scenarios

The aggregate impact of:

a. A financial market scenario under Section A above which would result simultaneously in the occurrence of R5; and
b. An aggregation of the three net underwriting losses under Section III above.

It is assumed that the underwriting loss events follow in quick succession and there is the inability to engage in capital or other fundraising activities. Further, it is assumed that there is no geographic correlation between these non-economic events. The insurer is to disclose its assumptions, including any magnified demand surge, if applicable, from the multiple events.

2. Insurer specific worst-case scenario

The insurer is to submit a description of its own worst-case annual aggregate loss scenario and the underlying assumptions. The scenario should be at a level considered extreme but plausible by the insurer.

G. REVERSE STRESS TEST SCENARIO

If an insurer performs reverse stress testing (as outlined in the CISSA IX(b) question 4), then the insurer is to provide the key assumptions, which includes specific market risk scenarios, loss figures and return period that would cause such business failure. Such scenarios should be reported and should be contrasted with the scenarios in the current guidelines, i.e. whether worse or better scenarios than those provided by the BMA cause the (reinsurance company to fail.

If the insurer does not perform Reserve Stress Tests, then insurers are to calculate the clearance between their available economic statutory capital and surplus and enhanced capital requirement (ECR) to determine the size of loss that would cause them to breach their ECR and provide the occurrence and relative return period of such event.

H. TECHNOLOGY RISK

If an (re)insurer that writes cyber risk (re)insurance products shall provide information on the cyber risk policies in force, cyber risk premiums and cyber risk claims/losses. The cyber risk policy with the largest exposure as well as the cyber underwriting risk appetite/limits shall be attached in the attachment section of the BSCR model. For non-cyber specific insurance policies, the (re)insurer shall disclose for the various lines of business whether cyber exclusion clause is applied consistently on all policies, and in cases where it is not, the estimated gross earned premium in the policy shall be disclosed. The (re)insurer shall describe their own cyber risk worst-case annual aggregate loss scenario and attach in the attachment section of the BSCR the underlying assumptions for the scenario.

All (re)insurers, including those that do not underwrite cyber risk, shall complete the questions in section 4 – 'Insurer own cyber security and resilience capabilities'. Responses will be selected from the drop down list or typed in as required and relevant documents will be included indicating the document name and identifying the applicable page numbers.