

# Aggregation Method Implementation (G) Working Group

November 19, 2025

## AMIWG Technical Group

- On June 9, AMIWG discussed and recommended creation of a group for stakeholders to provide technical input
- Three work areas -- valuation, scalars, and other tools
  - Drafting papers that will be used as reference by regulators as they review/finalize AM and recommend potential refinements for comparable implementation of the Insurance Capital Standard (ICS)
- Focus of the group will be on sensitivity to changes interest rates
  - Looking at the US system as a whole (not individual insurers) and on a forward-looking basis

## Upcoming Dates

- November 19 (2pm ET): AMIWG open call - work areas papers presented
- December 2: Final papers to be posted for NAIC National Meeting
- December 9 (2:15pm ET): AMIWG Session at NAIC National Meeting

# Questions / Comments / Suggestions?

# Impact of Scalars on the Sensitivity of the Aggregation Method to Changes in Interest Rates

**\*\*\*Draft for discussion by Aggregation Method Implementation (G) Working Group \*\*\***

In August 2025, the Aggregation Method Implementation Working Group (AMIWG) recommended using the Excess Relative Ratio (ERR) approach for purposes of planning the Final AM.<sup>1</sup> This proposal noted that scalars could address issues highlighted including sensitivity due to changes in interest rates. The purpose of this paper is to examine how the ERR scalars impact the AM's sensitivity to interest rates.

## Excess Relative Ratio Approach

The ERR scalar approach was developed to address concerns with volatility and cross-jurisdictional comparability. The method adjusts both available and required capital, with three main advantages: it is designed to adapt to changes in solvency regimes without introducing uneconomic volatility; it recognizes cross-jurisdictional differences in required reserves; and it produces results that are directionally consistent with the conversion of overseas capital into RBC terms.

The AM considers the Available Capital (AC) and Calculated Capital (CC) of each entity in an insurance group to determine the aggregated capital score. AC represents the entity's Capital & Surplus, or jurisdictional equivalent (Total Adjusted Capital (TAC) for U.S. insurers). Calculated Capital, also known as Required Capital in the US, represents the jurisdictional capital requirements (200% of the Authorized Control Level (ACL) for U.S. insurers). The ERR approach adjusts the CC for International insurers to align with RBC, then also adjusts AC to account for differences in reserve conservatism, recognizing that some jurisdictions have a regulatory approach that emphasizes reserves while others require greater capital. Because both AC and CC are sensitive to financial market conditions, particularly interest rates, the ERR scalar approach inherits sensitivity to changes in rate environments and constitutes a viable standard metric by which the U.S. will implement the ICS.

## Sample Calculation

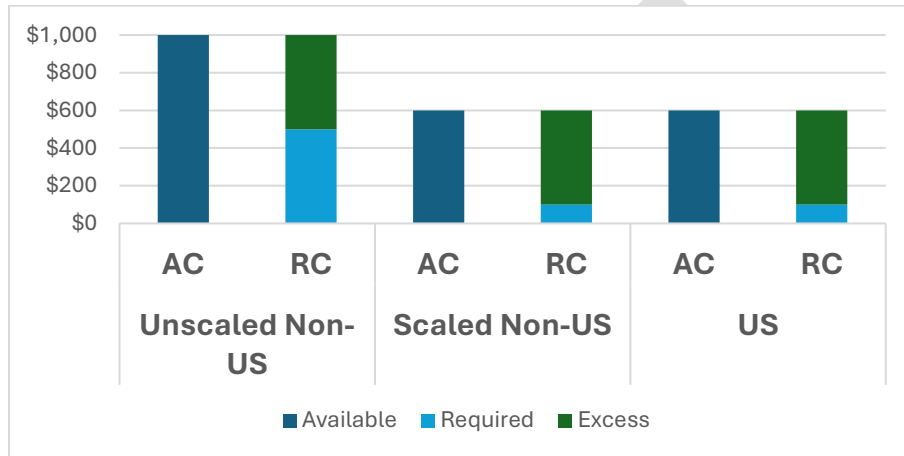
What follows is an example of how scaling impacts a group that has one US entity and one non-US entity in a "Regime A" that is typical of the non-US regimes that are material to the AM. Note that this is a hypothetical example but the underlying following stylized facts are

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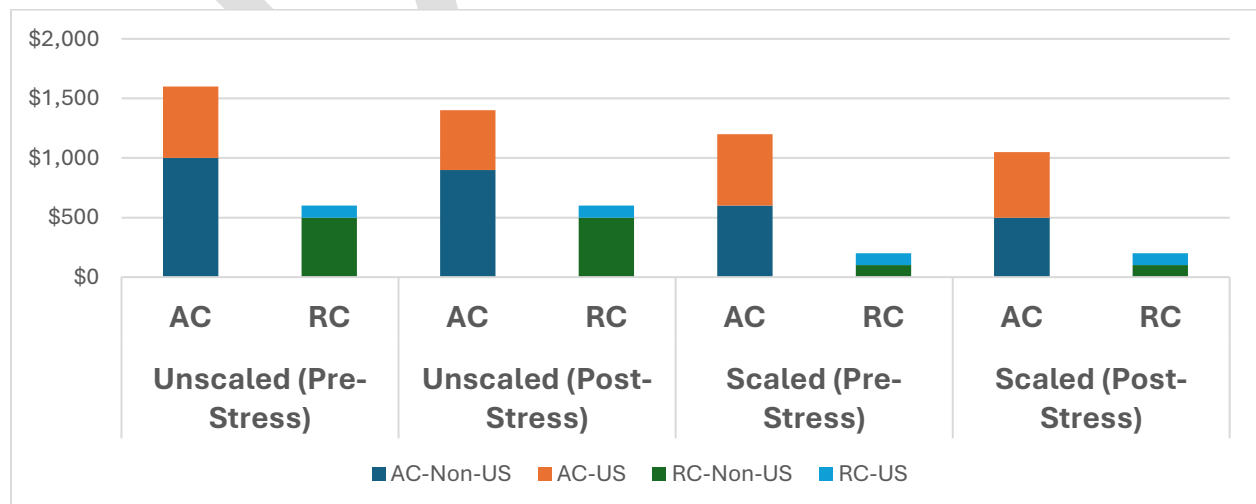
<sup>1</sup> [https://content.naic.org/sites/default/files/national\\_meeting/Materials%20-%20AMIWG%20Summer%20National%20Meeting%20081125.pdf](https://content.naic.org/sites/default/files/national_meeting/Materials%20-%20AMIWG%20Summer%20National%20Meeting%20081125.pdf)

based on empirical results from regimes where a less conservative approach to reserves (along with a correspondingly large capital requirement).

Assume that the two entities have the same excess capital of \$500 but the starting capital ratio is 200% for the non-US entity, 600% for the US entity and, for simplicity, that these are the same as the industry averages for the two regimes. The relatively large available and required capital in the non-US entity are brought down to the same level as in the US entity using a scalar of 0.20 ( $= [200\% - 100\%] / [600\% - 100\%]$ ) and an adjustment to the available capital to keep the excess unchanged.



Further, by scaling the available and required capital to similar levels, the ERR makes the sensitivity of group results to changes in individual entities more equal. For instance, assume there is an interest rate stress that results in a decrease in available capital of 100 for the non-US entity and 50 for the US entity. Before scaling, this would lead to a smaller percentage point decrease in the capital ratio for the non-US entity than for the US entity which may seem counterintuitive when analyzing group results. But after scaling this would lead to decreases that are proportional to the change in excess capital (i.e. from 600% to 500% for the non-US entity and from 600% to 550% for the US entity).



## **Conclusion**

A scalar adjusts for differences in the level of calibration between different types of capital requirements and differences in valuation between the entities. The ERR approach adjusts available and required capital to produce the same average solvency ratio in each jurisdiction while keeping the excess capital (i.e. the amount by which available exceeds required capital) unchanged for each individual entity. The inputs to this calculation are sensitive to changes in interest rates and the resulting scalar helps adjust for any resulting differences.

DRAFT

# Interest Rate Sensitivity in US Statutory Reserving

DRAFT

December 2, 2025

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## Executive Summary

This paper will discuss how US statutory reserving requirements respond to changes in interest rates. There will be a brief discussion of formulaic reserves, with more detailed discussions of Principle Based Reserve (PBR) methods and assumptions, as well as asset adequacy testing (AAT) and risk based capital (RBC).

More specifically, for PBR this paper will focus on Valuation Manual (VM) section 20 (VM-20) covering life insurance products, VM-21 (variable and registered index-linked annuities), and VM-22 (fixed deferred and payout annuities). The reserves calculated under each VM chapter are discussed, focusing on the components that are interest rate sensitive. AAT, covered under VM-30, acts as an umbrella over statutory reserving with interest rate sensitivity a key risk to assess.

Asset/liability matching (ALM) as it relates to PBR and AAT and interest rate risk under RBC will also be discussed.

VM-20 was effective January 1, 2017 with a three year transition period applicable for new issues. A universal life with secondary guarantees (ULSG) product will be shown below. VM-21 was effective January 1, 2020 with a three year transition period and is applied retrospectively. VM-22 is effective January 1, 2026 with a three year transition period for new issues. Retroactivity is currently under discussion for VM-22; any retroactivity will be effective no earlier than the 2027 VM. A fixed deferred annuity product will be shown below.

VM-20 utilizes a three pronged approach to reserving. There is a stochastic reserve (SR), a deterministic reserve (DR) and a net premium reserve (NPR). There is also a cash surrender value floor and a cost of insurance floor. The SR utilizes a wide range of interest rate scenarios. The DR uses a specified interest rate scenario and the NPR is a formulaic reserve. Most of the focus of this paper is on the SR as the SR is most reflective of changes in interest rates; the DR will also exhibit interest rate sensitivity, albeit on one economic scenario. There is also a stochastic exclusion test (SET) and a deterministic exclusion test (DET) that can exempt companies from calculating the SR, DR or both. Typically, the exclusion tests will not exempt interest sensitive products. Certain products are not eligible for the SET and DET such as most ULSG. Term is not eligible for the DET.

The main element of the SR is the CTE70 of the scenario reserves, where CTE70 is the average of the highest 30% of the scenario reserves. The scenario reserve reflects starting assets as well as asset shortfalls that occur over the projection period. Interest rate sensitivity occurs through changes in asset and liability cash flows due to changes in interest rates, affecting items such as discount rates, reinvestment yields, investment income, liability cash flows through dynamic lapse and changes in crediting rates (e.g., if there is a reduction in spread due to guaranteed minimum crediting rates), as applicable to a particular product.

Under VM-21, the SR<sup>1</sup> plus any Additional Standard Projection Amount (SPA) is the reserve for many contracts. The SR is the CTE70 of scenario reserves. Each scenario reserve reflects starting assets as well as asset shortfalls over the projection period. The SPA uses prescribed assumptions and other adjustments and, if positive, is added to the SR. In other words, the SPA becomes a floor on the VM-21 reserve.

An Alternative Methodology is available for VM-21 contracts that contain only Guaranteed Minimum Death Benefits (GMDBs) or no guaranteed benefits at all. This reserve is the cash surrender value plus a factor applied to each product.

In general, interest rate sensitivity in VM-21 is captured through impacts on contract guarantees on withdrawals, payouts, and death benefit, as well as yields on general account assets and contract crediting rates.

VM-22 has many similarities with VM-21. The SR is calculated in a similar manner, the CTE70 of scenario reserves. VM-22 also has an SPA. The SPA is currently a disclosure item. However, when the SPA is greater than 0 the actuary should strengthen SR assumptions and/or margins to reduce the SPA to 0, unless the reason for differences between the SR and SPA are due to company assumptions that are backed by credible and appropriate experience data. There is also a DR method for certain eligible blocks of business. Blocks of business will either calculate the SR and SPA or the DR.

Reserves for products under VM-20 and VM-22 were run under 9/30/2025 interest rate scenarios at policy inception using the new National Association of Insurance Commissioners (NAIC) Generator of Economic Scenarios (GOES). ULSG was run under VM-20 and a fixed deferred annuity with a guaranteed living withdrawal benefit (GLWB) was run under VM-22. 1,000 scenarios as of 9/30/2025 were used for each of the baseline runs as well as two shock scenarios, 100 bps up and 100 bps down.

The shock scenarios were simplified from what would occur under PBR. The shocks parallel shifted the 9/30/2025 scenarios up or down by 100 bps. If treasuries moved by 100 bps, that new initial curve would be used to generate new interest rate scenarios under PBR. The simplification used may overstate the change in reserve described below because the parallel shift in the interest rate scenarios does not reflect the mean reversion that would occur in a regeneration of interest rate scenarios from a lower or higher initial treasury curve. Another factor impacting results is if the mean reversion parameters are changed as rates change. This is a lesser concern in that the parameters will undergo routine review periodically, likely every few years. It is also difficult to predict the impact on results.

It should also be noted that under PBR, the various reserve floors may appear to reduce or eliminate interest rate sensitivity because the floors happen to determine the reserve rather than the detailed reserve calculations. The examples use unfloored SR's to show the interest rate sensitivity inherent in the PBR reserve calculation.

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<sup>1</sup> Terms used throughout this paper are as defined in the various VM chapters. For example, the SR in VM-20 is not the same as the SR in VM-21, yet SR is used to describe both.

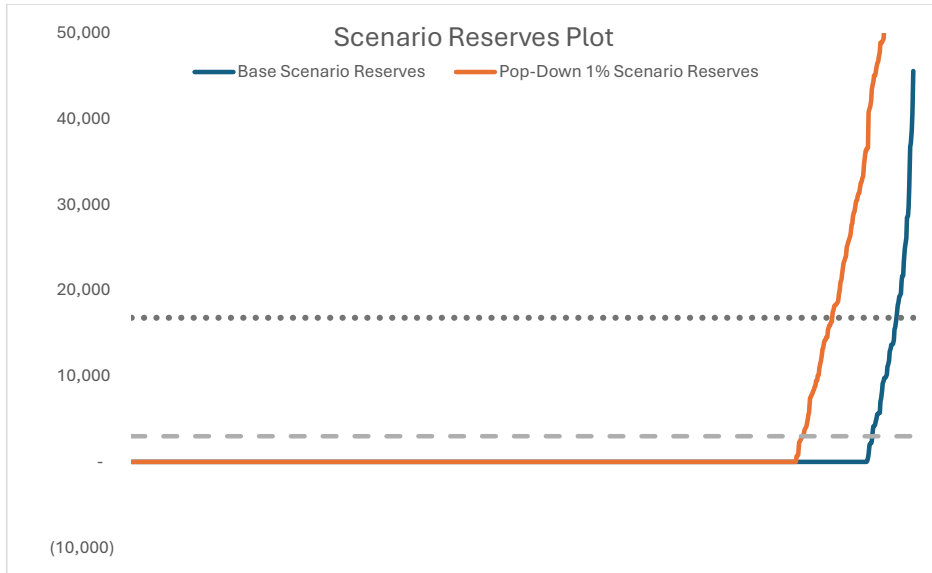
The ULSG product was designed with a lifetime secondary guarantee using a shadow account with target premiums that will maintain the secondary guarantee through attained age 121. The product was run under VM-20 at issue ages 55, 65, and 75, each with a \$500,000 face amount. Each run was separate. An attribution analysis of the change in reserve was performed on the age 65 cell. In addition, age 65 was run with a shorter reinvestment duration, demonstrating the impact of duration mismatch on reserves.

The results are as follows:

	Stochastic Reserves CTE70			
	9/30/25 GOES	1% Pop-Down	1% Pop-Up	Diff (\$) Pop-Down vs Base / Pop-Up vs Base
55 Year Old Cell	21,701	43,908	2,451	22,207 / -21,701
65 Year Old Cell	2,991	16,808	0	13,816 / -2,991
75 Year Old Cell	-	70	0	70 / 0
65 YO Cell; Shorter Reinv <sup>2</sup>	6,575	21,892	89	15,317 / -6,486

The scenario reserves for the age 65 cell for both the baseline and 100 bps shock down are shown below:

<sup>2</sup> Shorter reinvestment assumption is 50% 5-year; 35% 10-year; 15% 20-year



In addition an attribution analysis was performed on the age 65 cell, showing the major components impacting the reserve change. As expected, lower interest rates increased the reserve from \$2,991 to \$16,808.

	Stochastic Reserves	Attribution Impact	Attribution Step
<b>Baseline</b>	<b>2,991</b>		
		9,880   +72%	Investment Income
		2,107   +15%	Discount Vector
		1,829   +13%	Residual
<b>1% Pop-Down</b>	<b>16,808</b>		

Lower investment income due to lower reinvestment yields resulted in higher asset shortfalls and starting assets that need to be accounted for in the reserves, making up more than 2/3 of the change in reserve. The discount rates decreased by close to 100 bps in the shock down run impacting the present values of asset shortfalls.

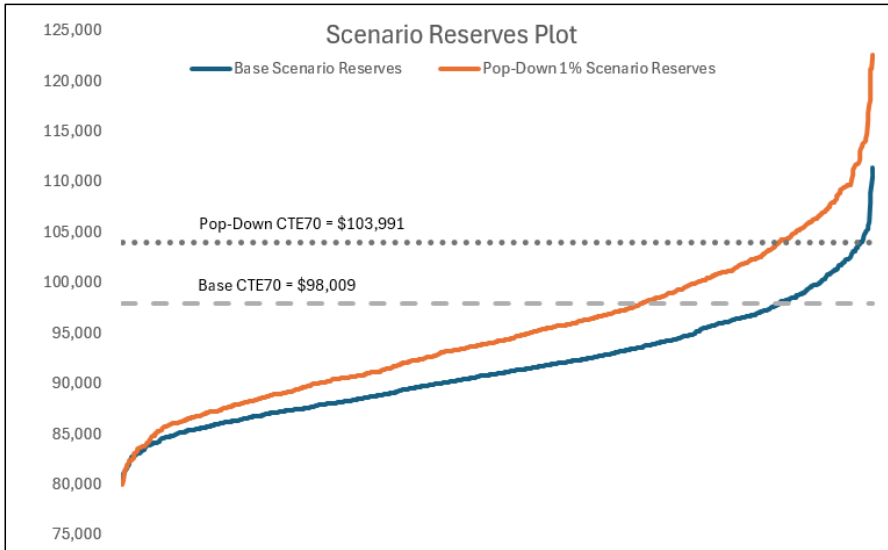
The 7 year surrender charge fixed deferred annuity with a one year interest rate guarantee was run under VM-22 at issue ages 55, 65 and 75, each with a \$100,000 single premium. The guaranteed minimum interest rate is 3.0%. Each run was separate. An attribution analysis of the change in reserve was performed on the age 65 cell. In addition, age 65 was run with a shorter reinvestment duration, demonstrating the impact of duration mismatch on reserves.

The results are as follows:

	Stochastic Reserves UNFLOORED CTE70			
	9/30/25 GOES	1% Pop-Down	1% Pop-Up	Diff Pop-Down vs Base / Pop-Up vs Base
55 Year Old Cell	93,476	101,398	89,173	+8.5% / -4.6%
65 Year Old Cell	98,009	103,991	93,859	+6.1% / -4.2%
75 Year Old Cell	90,728	91,251	90,499	+0.6% / -0.3%
65 YO Cell; Shorter Reins <sup>3</sup>	99,481	105,900	94,794	+6.5% / -4.7%

The scenario reserves for the age 65 cell for both the baseline and 100 bps shock down are shown below:

<sup>3</sup> Shorter reinvestment duration assumption is 50% 5-year; 35% 10-year; 15% 20-year



In addition an attribution analysis was performed on the age 65 cell, showing the major components impacting the reserve change. As expected, lower interest rates increased the reserve from \$98,009 to \$103,991.

	Stochastic Reserves UNFLOORED CTE70	Attribution Impact	Attribution Step
<b>Baseline</b>	<b>98,009</b>		
		3,331   +56%	Discount Vector
		1,963   +33%	Investment Income
		691   +12%	Withdrawals
		(4)   0%	Residual
<b>1% Pop-Down</b>	<b>103,991</b>		

The discount rates decreased by close to 100 bps in the shock down run, making up more than ½ of the change in reserve. Lower investment income due to lower reinvestment yields resulted in higher asset shortfalls that need to be accounted for in the reserves. Lower interest rates means

that lapses will tend to decrease. Lower lapses means the level of withdrawals under the GLWB will increase (more people to use the benefit), increasing the required reserves.

In addition to a dynamic and responsive reserve framework, actuaries are required to perform AAT each year. AAT acts as an umbrella over reserve frameworks to help ensure adequate reserves over a wide range of interest rates, with appropriate conservatism to model moderately adverse conditions (loosely defined as CTE70 or the 85<sup>th</sup> percentile of results as the intent is to test reserves at a similarly conservative level at which reserves are set).

Cash flow testing (CFT) is the most appropriate AAT method for interest sensitive products. CFT generally allows for aggregation within legal entity, allowing sufficiencies to offset deficiencies between blocks. To the extent that the actuary or regulator believes that standalone testing of a particular block is required, additional testing may be performed. CFT sets assets equal to reserves at time 0 of the valuation. Both the assets and liability cash flows are valued over a wide range of interest rate scenarios. There must be sufficient cash inflows to cover cash outflows over time in those scenarios in moderately adverse conditions. If cash flows are not adequate in enough scenarios, reserves may need to be strengthened.

Asset liability management (ALM) is recognized both in PBR and CFT. In general, the greater the mismatch between asset and liability durations, and in some cases convexity, the larger the reserve under PBR will be. Under the wide range of interest rate scenarios run under both PBR and CFT, mismatches that exist at the start of the model run and those that either are created or exacerbated during the model run will be recognized. In the case of PBR, the reserve will be higher. For CFT, there will either be smaller surpluses or larger deficiencies and an increased likelihood of requiring asset adequacy reserves.

For the ULSG example, in the table below, the baseline asset and liability durations are X and Y, respectively, resulting in a Z year mismatch. The issue age 65 example uses a shorter reinvestment duration. The asset and liability durations are A and B, respectively, resulting in a C year mismatch. The mismatch alone results in a reserve increase.

Commented [BF2]: Values being calculated.

	Stochastic Reserves UNFLOORED CTE70			
	9/30/25 GOES	1% Pop-Down	1% Pop-Up	Diff (\$) Pop-Down vs Base / Pop-Up vs Base
65 Year Old Cell Baseline Reinvestment Duration (33% 5yr; 33% 10yr; 33% 20yr)	2,991	16,808	2,451	13,816 / -2,991
65 Year Old Cell Shorter Reinvestment Duration (50% 5yr; 35% 10yr; 15% 20yr)	6,575	21,892	89	15,317 / -6,486

For the deferred annuity example, in the table below, the baseline asset and liability durations are X and Y, respectively, resulting in a Z year mismatch. The issue age 65 example uses a shorter reinvestment duration. The asset and liability durations are A and B, respectively, resulting in a C year mismatch. The mismatch alone results in a reserve increase.

Commented [BF3]: Values being calculated.

	Stochastic Reserves UNFLOORED CTE70			Diff Pop-Down vs Base / Pop-Up vs Base
	9/30/25 GOES	1% Pop-Down	1% Pop-Up	
65 Year Old Cell Baseline Reinvestment Duration (33% 5yr; 33% 10yr; 33% 20yr)	98,009	103,991	93,859	+6.1% / -4.2%
65 Year Old Cell Shorter Reinvestment Duration (50% 5yr; 35% 10yr; 15% 20yr)	99,481	105,900	94,794	+6.5% / -4.7%

Under RBC, interest rate risk is accounted for by factors applied to low, medium and high risk products. The higher the risk, the higher the factor and required capital. In addition, there are model based methods that either add or subtract from the required capital. Fixed deferred annuities, immediate annuities, structured settlements, and guaranteed investment contracts, and single premium life insurance use the CFT models and conservative prescribed scenarios. The methodology used for these contracts, described later in the paper, is designed to approximate the 95<sup>th</sup> percentile. Interest rate risk is taken into account through running multiple interest rate scenarios, valuing both assets and liabilities in each scenario as in CFT.

Variable annuities calculated CTE98 (average of the 2% worst scenario reserves) following the VM-21 SR methodology and a separate calculation for contracts following the alternative methodology. By using PBR models, interest rate risk will be accounted for in the same manner, by determining asset and liability values over a wide range of interest rate scenarios and accounting for scenario short falls in the scenario reserve calculations. The methodology also takes the SPA into account. The capital calculations use much deeper in the tail calculations.

## Introduction

The purpose of this paper is to demonstrate interest rate sensitivity under PBR. Descriptions of PBR are based on the 2026 VM. The examples shown are based on September 30, 2025 GOES interest rate scenarios and shocks of those scenarios. The examples are hypothetical and to the best of my knowledge are reasonable representations of products available in the US.

The intended users of this paper are US and international regulators, specifically those regulators working on standards for the Aggregation Method (AM) of group capital in the US and international regulators working on Insurance Core Standards (ICS) for group capital under the auspices of the International Association of Insurance Commissioners (IAIS).

I, Bruce A. Friedland, am an Actuarial Strategist with Friedland Actuarial. I am a member of the American Academy of Actuaries. I meet the Academy qualification standards to render the opinions expressed in this paper. I have prepared this paper along with the conclusions contained herein. Thomas Wurfel, FSA, MAAA, President of Allen Bailey and Associates, has developed the models, analysis and results. I have reviewed the analysis and results and have had discussions with Mr. Wurfel, so that we agree on the analysis and conclusions contained herein. I am able to provide any supplementary information and explanation. Neither I nor my firm have any conflicts of interest in provide the information and opinions in this report.

Actuarial methods, considerations and analyses used in the preparation of this paper conform to the appropriate standards of practice as promulgated by the Actuarial Standards Board, which standards form the basis for this paper.

## Background

Reserves are set under statutory principles to provide protection to policyholders and promote company solvency against adverse fluctuations.<sup>4</sup>

Until relatively recently, life insurance reserves were formulaic. Reserves per unit could be derived for all future periods. Reserves could be determined from table look ups. Reserves often followed approaches like the Net Level Premium Method (NLP) and later the Commissioner's Reserve Valuation Method (CRVM) for life insurance, and the Commissioner's Annuity Reserve Valuation Method (CARVM) for annuities. Prescribed mortality and discount assumptions were set conservatively and additional conservatism was added by flooring the calculated reserve at the contract's cash surrender value.

In the early 1990's, it was recognized that assets backing reserves also needed to be evaluated. AAT began. For products that are interest sensitive, CFT is generally the appropriate asset adequacy method. CFT models use moderately adverse assumptions and test whether the assets backing the tested blocks of business are sufficient, along with future premiums, to pay liabilities as they come due over the lifetime of the policies tested. CFT is performed over a wide range of

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<sup>4</sup> 2026 Valuation Manual -redline p.5. All references throughout this document is to the 2026 Valuation Manual.

interest rate (and equity, if applicable) scenarios. The tested scenarios may be deterministic, stochastic or both deterministic and stochastic. To the extent that ending negative surplus (ending deficiencies) or material negative interim surplus (interim deficiencies) amounts occur in enough scenarios involving moderately adverse conditions, the company's appointed actuary may conclude that additional reserves need to be held. The additional reserve amount and accompanying assets should result in projections using the same moderately adverse assumptions and conditions where there is no longer negative ending or material interim deficiencies. Because the starting assets are set equal to the initial reserve (including any additional asset adequacy reserve), CFT identifies an appropriate total reserve amount reflecting moderately adverse conditions for the blocks of business tested.

As products became more complex, especially with the advent of ULSG, a reserve regime, PBR, was contemplated in the early 2000's where an economic reserve would be calculated and held as the liability for policyholder benefits. That economic reserve would use best estimate assumptions along with appropriate conservatism through provision for adverse deviation (PAD or margin).

The reserve calculation would use modeled projections of cash flows rather than formulaic methods. As a result, the reserve would be more responsive to product liability, related asset, and economic risks. The reserve framework would be a flexible chassis used to respond to product innovation and changes in risk profile of those products, without having to change the reserving structure. As a result, PBR would account for product complexity, creating reserves reflective of product and product related risks. To the extent that the appointed actuary believes that the methods, assumptions and models do not produce adequate reserves, additional reserves may be held. PBR has flexibility built into the reserving framework because the actuary can choose to set non-prescribed assumptions and margins (called a prudent estimate assumption) at an appropriate level to reflect product risks and data credibility. PBR includes minimum reserve requirements, including the cash surrender value floor, to ensure assumptions or margins are not too aggressive.

Under PBR and AAT, sensitivity tests of key assumptions are expected. For the most part the tests are meant to represent reasonable deviation from the baseline assumptions used in the model. Sensitivity tests help identify material risks and they also demonstrate how the reserving framework responds to reasonable assumption deviations. For example, under CFT, a mortality sensitivity test may show that further conservative deviation in mortality from the already conservative baseline mortality assumption would still not result in requiring asset adequacy reserves.

In both the case of PBR and AAT, detailed reports are required. An actuarial memorandum is required under VM-30 to support the appointed actuary's Statement of Actuarial Opinion for the year. Detailed PBR reporting requirements are included in VM-31. Both documents help regulators understand key product risks as well as company actions taken to mitigate those risks. The reports provide a great deal of transparency for the regulators.

Additionally, VM-G established PBR governance requirements for company board of directors, senior management and qualified actuaries (those actuaries responsible for PBR calculations).

Companies are also required to calculate and hold Risk Based Capital (RBC). Required capital charges use factors assigned to asset, pricing, reinsurance and business risks. There are also

model based methods to evaluate interest rate risk on certain products, in addition to factor charges. Levels of capital are defined where the company is expected to either add surplus or reduce risk, or where regulator intervention is indicated. Competitive pressure and company prudence result in companies holding multiples of these levels.

As a broad generalization, reserves are held to cover risk at around the 85<sup>th</sup> percentile of potential outcomes and capital is held for risks around the 95<sup>th</sup> percentile or deeper in the tail, depending on block.

As will be noted in the sections below, PBR and CFT reflect interest rate risk and respond to changes in interest rates. This occurs through regular updates in economic scenarios, their corresponding impacts on discount rates, and taking into account changes in policy holder behavior tied to changes in interest rates. Assumptions are also routinely updated and must be supported by data, credibility analysis, sound actuarial judgment and, in some cases, prescription.

## VM-20

VM-20 was effective on a prospective basis for issues beginning 1/1/2017 or later, with a 3 year transition period. As a result, unless a company satisfied a size based or a limited product based exemption, new life insurance contracts needed to be valued on a PBR basis beginning 1/1/2020.

VM-20 prescribes up to 3 different reserve calculations. Companies may need to calculate an SR, a DR and an NPR. If the company passes the Stochastic Exclusion Test (SET) discussed later, then the DR and NPR are calculated. If the company passes both the SET and the Deterministic Exclusion Test (DET) then only the NPR is calculated. Interest sensitive products will tend to fail the SET, which means all 3 reserves must be calculated. ULSSG with anything other than a non-material secondary guarantee (defined in the VM) is not eligible for the SET or DET. . Term contracts are not eligible for the DET.

The SR and DR calculations are aggregated, model based reserves and the NPR is seriatim and formula based. For a given group of policies calculating all 3 reserves, first determine the sum of the seriatim NPR's, subject to the seriatim cash surrender value and seriatim cost of insurance to the next processing date ( $\frac{1}{2} c_x$ ) floors, less any due and deferred premium for those policies. Next determine the greater of the DR and SR for those same policies. Determine the pre-tax interest maintenance reserve (PIMR) for each of the DR and SR blocks, and reduce the DR and SR by the applicable PIMR. Finally add the excess in the prior step to the NPR less due and deferred premium in the first step. Effectively, the PBR is set at the highest of the 3 values.

As an example, assume, after application of the cash surrender floor and  $\frac{1}{2} c_x$  to the NPR:

NPR for all policies = \$10,000

Due and Deferred Premium for all policies = \$1,000

SR = \$13,500

DR = 11,000

$PIMR_{SR} = PIMR_{DR} = 0$

$$\begin{aligned}
 \text{PBR} &= \text{NPR} - \text{Due and Deferred Premium} + [\text{Max}(0, \text{Max}((\text{SR} - \text{PIMR}_{\text{SR}}, \text{DR} - \text{PIMR}_{\text{DR}}))] - (\text{NPR} - \text{Due and Deferred Premium}) \\
 &= 10,000 - 1,000 + [\text{Max}(0, (\text{Max}(13,500, 11,000))] - (10,000 - 1,000)] \\
 &= 9,000 + [13,500 - 9,000] = \$13,500
 \end{aligned}$$

Additionally, VM-20 defines different reserving categories. They are the term reserving category, ULSG reserving category and all other VM-20 reserving category. As a general rule, final VM-20 reserves are determined based on aggregated results at the reserving category level.

Exclusion tests are used to identify policy groups that should be or may not electively be subject to the SR, based on the sensitivity of reserves over a range of interest rate (and equity, if applicable) scenarios, or the DR. The exclusion tests help to right size the effort in calculating reserves while ensuring the appropriate reserve(s) is calculated based on the inherent risks in the product. If products are not sensitive to interest rates, then reserves will tend to not vary significantly over a broad range of interest rate scenarios. As a result, it is extraneous work to calculate reserves over many scenarios in that circumstance; an appropriate reserve can be determined with one interest rate scenario. Policies that are interest sensitive will tend to fail the SET or may not even be eligible for exclusion. As a result, all 3 reserves need to be calculated for interest sensitive policies. There is also no SET available for any group of policies that utilizes a future hedging strategy, unless the hedge is for a low utilization, immaterial benefit. Alternatively, companies always have the option to calculate all 3 reserves and not perform the SET.

There are 3 different stochastic exclusion tests, only one of which needs to be passed (there are also rules about failing one test then trying another, which is outside the scope of this paper). The first one is the Stochastic Exclusion Ratio Test (SERT). This test is calculated annually and within 12 months of the PBR valuation date. The SERT entails calculating an adjusted DR individually for each of 16 defined interest rate scenarios in VM-20. The baseline scenario uses the prescribed economic scenario generator and no interest rate shock. The baseline is subtracted from the largest DR from the other 15 DR's. This difference is divided by the present value of future net (of reinsurance) benefits from the baseline scenario in order to normalize the results between the two scenarios. The SET is satisfied if this result is less than 6%. The inference is that if the SERT is less than 6%, then the product group is less interest sensitive and conversely more interest sensitive if the ratio is over 6%. Because the 16 scenarios test various interest rate (and equity) shocks, a wider range of results suggests more interest rate sensitivity and the need to calculate stochastic reserves. VM-20 permits using a gross premium reserve from the company's asset adequacy models (with a couple of modifications for added conservatism) instead of the DR, calculating the SERT in the same manner.

As an example of the SERT, consider a baseline result of \$120 million, the largest adjusted DR of \$130 million and a present value of future net benefits of \$240 million. The SERT is 4.2%, and an SR is not necessary. Instead let the largest adjusted DR = \$135 million. The SERT is 6.25% and the SR must be calculated.

The second test is the Stochastic Exclusion Demonstration Test (SEDT). This test is conducted at the time of PBR implementation and at least once every three years thereafter. The SEDT entails periodically calculating the SR for the group of exempted policies. The DR for those policies is

compared with the NPR less due and deferred premium. The larger of those two reserves are compared to the SR and as long as that reserve is larger than the SR, the SEDT is passed.

If  $\text{Max} [\text{DR}, \text{NPR} - \text{due and deferred premium}] > \text{SR}$ , then the SEDT is passed.

The SEDT also permits other variations using some of the scenario reserves that make up the SR or risk based demonstrations, however the objective is the same. This is to show that the reserves that will be calculated if the SEDT is passed are at least as large as the SR. The SEDT captures interest rate risk, or the lack of it, by requiring an SR or similar calculation and comparing it to a single scenario and a formulaic reserve.

The final test is the SET Certification Method. This is a certification that one of the other two methods has been passed within the past 3 years and that there have not been material changes in interest rate or asset return volatility risk for the policies and their supporting assets subject to the certification.

The next step is to determine if the group of contracts passes the Deterministic Exclusion Test (DET). If the group of contracts pass the DET, the reserve is the NPR – due and deferred premium. There are certain products that are not eligible for the DET. This includes ULSG, unless the secondary guarantee is “non-material,” as well as term insurance policies and term riders. Additionally, any group of policies that fail the SET must also calculate the DR. The DET Net Premium Test is a demonstration that the sum of gross premiums exceeds the sum of valuation net premiums, indicating an adequate premium is being charged to the policyholder compared to premiums based on reserve assumptions of interest and mortality. There is also a certification method available. As a broad generalization, the DET is structured to compare premiums because interest sensitive contracts would have failed the SET and would not be eligible for the SET.

The SR requires calculating a series of scenario reserves, one for each interest rate scenario. Technically there can be multiple model segments due to different products or product series, all with their own cash flows and assumptions, including discount rates; this paper will ignore multiple model segments for brevity. The scenario reserve is the sum of the starting value of assets used in the model plus the greatest discounted value of the negative of projected assets. The discount rate will be described below. By using the negative value, the reserve will be reduced by positive asset values and increased by negative ones. Scenario reserves are ranked and the average of the CTE70 of reserves becomes the SR. The qualified actuary can add additional amounts if any material risk cannot be explicitly modeled.

For a given scenario reserve, asset and liability cash flows are projected to the point where no obligations remain. This avoids ignoring material potential losses past a certain projection point and inconsistency of practice from company to company, should more subjective criteria be used. The cash flows reflect margin in each assumption, some prescribed and some based on judgment. In general, the less credible the data used to set the margin and/or the more volatile the assumption, the larger the margin should be.

Interest rate scenarios are determined from a prescribed interest rate generator, GOES. Alternatively, companies can use their own interest rate scenario generator if they can demonstrate that reserves will not be materially less than those calculated with GOES scenarios. The company must run a sufficient number of scenarios to cover a wide range of interest rates. They must

demonstrate that enough scenarios have been run and that the SR would not materially increase if a larger number of scenarios were run. The DR utilizes a prescribed scenario, SERT scenario 12.<sup>5</sup> The impact of using the GOES scenarios may be phased in over a three year period beginning on January 1, 2026.

While the GOES model governance is still in draft form, it is scheduled to be discussed at the NAIC's fall meeting in early December. The current draft calls for monthly updates to the Treasury model to reflect starting conditions. At the beginning of each year an annual review will take place. Back testing will be used to compare the projected results to the actual previous year data. Recommendations will be made and considered as to whether model parameters need to be updated. A review will be conducted every five years to recalibrate the GOES model. Finally, the current draft addresses off cycle updates. Updates may be indicated and will be taken if there is a significant change in economic conditions, a change in Federal Reserve policy, model findings, failure to meet acceptance criteria, or insurance product changes that indicate a need for new GOES functionality or an emphasis on certain risks.

Cash flows include any material income or benefit item such as mortality, lapse/surrender, expenses, commissions, net investment income (net of default costs and investment expenses, realized capital gains/losses, and hedges) and reinsurance. Any non-guaranteed elements (NGE) projected should reflect any guarantees as well as past NGE practices and policies. Further, the projection of NGE's must be consistent with experience assumptions in each scenario. For example, if interest rates increase, dividends are also expected to go up. Inconsistent treatment could be maintaining the current dividend scale. Similarly, a reasonable expectation is that non-guaranteed crediting rates must increase as interest rates increase. Policyholder behavior assumptions must also be consistent with the projected NGE's and the economic scenario. For example, it would not be reasonable for the company to assume that policyholders would continue to accept lower rates and the company would reap higher spreads when competitors offer higher rates.

Starting asset amount cash flows are projected using appropriate techniques and those projected asset amounts must be consistent with the value of the starting assets at the beginning of the projection.

The company chooses its own reinvestment assumption consistent with its current reinvestment practice or its anticipated and supportable future practice, if different. The company also must calculate a guardrail assumption using high quality public non-callable corporate bonds and must use the more conservative of the two assumptions. Spreads over treasuries are prescribed and are updated each year. Current spreads are used in projection year 1 (subject to adjustments detailed in VM-20), grading to long term spreads beginning in projection year 4 and later. The projection year is always counted from the model start date, so this process occurs at each valuation. There are also current and long term swap spreads. The spreads vary based on credit rating and the weighted average life of the projected asset. Spreads are updated monthly.

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<sup>5</sup> For the DR, the prescribed interest rate scenario, Scenario 12 of the SERT scenarios, is described for interest rates in VM-20 as *uniform downward shocks each month for 20 years such that interest rate levels are approximately at the one standard deviation down level(16%) from the stochastic distribution of interest rates. After year 20, very small positive uniform shocks are applied to allow interest rates to approximately revert to their long-term median levels.*

Discount rates are determined differently for the DR and the SR. For the SR, the discount rate is 105% of the path of one-year treasury rates for each projection year for each scenario reserve. The SR discounts excess or insufficient asset amounts in this manner, as the discount rate reflects the *marginal* assets required to eliminate any small asset overage or shortfall over the projection period. These amounts tend to be small and the discount rate is not as critical because the starting asset amount requirements result in a starting asset amount between 98% and 102% of the modeled reserve. However, there is discussion about adopting an NAER approach for consistent with other VM chapters.

For the DR, the discount rate is based on the net asset earned rate (NAER) along scenario 12. The DR methodology uses an actuarial present value of premiums, benefits and expenses methodology. As a result, the NAER represents the approximate earned rates on assets for each year in the projection period for scenario 12. Loosely speaking, the NAER path is net investment income/invested assets at each projection point. There is an alternative method to calculate the DR which is that starting assets are iterated until all benefits and expenses are covered by the end of the projection horizon. There is no NAER needed here for discounting as there are no excess or shortfalls of assets to discount.

Assumptions such as interest rates or equities are required to be modeled stochastically in calculating the SR. Other assumptions can also be modeled stochastically. Any assumption that is not modeled stochastically is required to have appropriate margin; the less credible or supportable the assumption based on available data, the larger the margin should be. In addition, margins should vary as appropriate based on interest rate or equity scenario.

Policyholder behavior assumptions are also important for certain products. For example, if lapse behavior is expected to, or data shows, increases in lapses as rates rise because contract holder rates are locked in and competitor rates are higher (disintermediation risk), an appropriate scenario by scenario or dynamic formula assumption should be used.

Appropriate sensitivity tests are also performed. This helps identify key risks based on the product(s) being valued. In general, this includes any assumption not stochastically modeled.

As noted above there are numerous places where interest rates come into play in VM-20, impacting the reserve amount determined at the inception of PBR calculations. Starting assets reflect actual gross yields. These yields are then reduced by prescribed, conservative default costs and appropriate investment expenses. As those assets throw off coupons or other cash flows through the projection period, the conservative reinvestment strategy (the more conservative of the company's reinvestment strategy or the reinvestment guardrail) ensures continued conservatism throughout the projection period based on information that is known at the time.

Under US statutory reporting, reserves are required to be reported quarterly. At that point, assumptions are updated, as appropriate. For example, mortality experience rarely moves in such a way that a quarter's worth of experience changes results materially; annual updating is usually sufficient. Interest rate scenarios, in force listings and starting assets are updated quarterly. To the extent interest rates have moved over the quarter those changes are reflected in all impacted areas of the calculations such as reinvestment yields, discount rates and dynamic lapse assumptions.

These changes will be discussed further in the example below.

## VM-20 Examples

This is an example of a day one<sup>6</sup> reserve calculation for a universal life with lifetime secondary guarantee via shadow account feature.

Reserves were run under the 9/30/2025 GOES scenario set, along with a 1% parallel shift up (1% pop-up), and a 1% parallel shift down (1% pop-down) of the 9/30/2025 GOES scenario set.

## Product Design/Details

The ULSG product is designed so that target premiums will maintain the secondary guarantee through attained age 121. The product will offer minimal opportunity for cash value accumulation at current crediting rates levels and expense charges.

## Liability Assumptions and Margins

The best estimate lapse assumption for the first twelve years is 3.0%/3.0%/2.5%/2.5%/2.0%/2.0%/2.0%/2.0%/2.0%/2.0%/2.0%/2.0%, then 3.5% thereafter. A 50% dynamic lapse adjustment is applied when the account value is greater than \$0 and the secondary guarantee is paid-up. No lapses via dynamic adjustment is applied when the account value is less than \$0 and the secondary guaranteed is paid-up.

The best estimate mortality assumption to age 100 is 80% of 2015 VBT S&U assuming fully credible company data. From age 100, 100% of the 2015 VBT mortality is assumed. No mortality improvement was assumed.

Maintenance expenses assumed are 2% of premium and \$50 per policy per year with inflation tied to one-half the emerging 5-year treasury rate.

The commission rates assumed at target are 120% for Year 1 target premium, 3% for Years 2-10, and 2% thereafter.

Margins were applied to lapses, expenses, and mortality. The lapse margin applied decreased lapses by 10%. The expense margin applied increased expenses by 5%. The mortality margin applied is prescribed by VM-20 based on the assumption of the availability of fully credible company data. Separate prescribed margins were added to company experience mortality rates up to age 100 and to the applicable industry basic tables from age 100, detailed below.

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<sup>6</sup> Assets are purchased at time zero and the reserves are calculated the next day.

Margins applied from Issue Age 65 to age 100

**Limited Fluctuation Margins**

Assumed credibility level 93-100%

Attained Age	Factor	Attained Age	Factor
<46	4.0%	76-77	2.9%
46-47	4.0%	78-79	2.8%
48-49	3.9%	80-81	2.6%
50-51	3.9%	82-83	2.5%
52-53	3.8%	84-85	2.4%
54-55	3.8%	86-87	2.3%
56-57	3.7%	88-89	2.2%
58-59	3.6%	90-91	2.1%
60-61	3.5%	92-93	2.0%
62-63	3.5%	94-95	1.8%
64-65	3.4%	96-97	1.7%
66-67	3.3%	98-99	1.6%
68-69	3.2%		
70-71	3.1%		
72-73	3.0%		
74-75	2.9%		

Margins applied from age 100

**Industry Table Margins**

Attained Age	Factor
100-101	7.4%
102-103	6.7%
104-105	6.0%
106 and over	5.3%

**Asset Assumptions**

The initial asset portfolio is assumed to be a mix of BBB corporate bonds with semi-annual coupons. The maturities (weightings) are 5-year (20%), 10-year (40%), and 20-year (20%). The gross yields are assumed to be 5.50% / 5.75% / 6.00% respectively. Net yields are determined from the gross yields minus VM-20 prescribed defaults and minus an assumed 25bps investment expense.

The reinvestment asset assumption follows the VM-20 reinvestment guardrail, 50% AA and 50% A corporate bonds with semi-annual coupons. The assumed reinvestment maturities (weightings) are 5-year (33.33%), 10-year (33.33%), and 20-year (33.33%). Gross yields are determined from the treasury yields within each scenario reserve projection plus VM-20 prescribed spreads minus VM-20 prescribed defaults minus an assumed 25bps investment expense. The prescribed spreads grade from the investment grade current benchmark spreads in projection year 1 to the investment grade long-term benchmark spreads over 4 years.

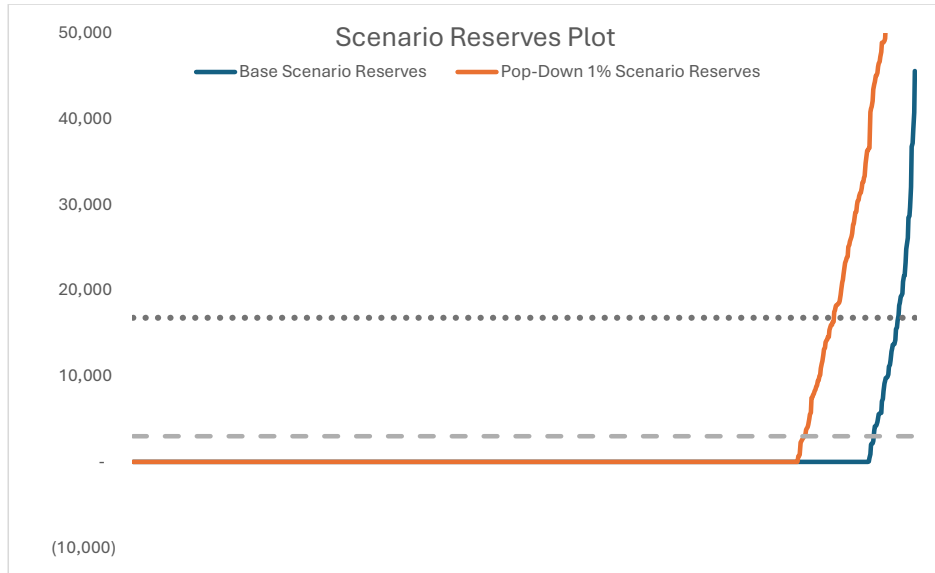
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## Results

The results for modeled ages 55, 65, and 75 are shown below along with a shorter duration reinvestment assumption using the modeled age 65.

	Stochastic Reserves UNFLOORED CTE70			
	9/30/25 GOES	1% Pop-Down	1% Pop-Up	Diff (\$) Pop-Down vs Base / Pop-Up vs Base
55 Year Old Cell	21,701	43,908	2,451	22,207 / -19,250
65 Year Old Cell	2,991	16,808	0	13,816 / -2,991
75 Year Old Cell	-	70	0	70 / 0
65 YO Cell; Shorter Reins <sup>7</sup>	6,575	21,892	89	15,317 / -6,486

<sup>7</sup> Shorter reinvestment assumption is 50% 5-year; 35% 10-year; 15% 20-year



### Attribution Analysis

An attribution analysis was performed for the age 65 cell between the baseline and the 1% pop-down scenario to determine the interest rate sensitivity in the stochastic reserve. The key interest rate sensitive drivers identified are (1) the discount vector and (2) investment income.

	Stochastic Reserves	Attribution Impact	Attribution Step
<b>Baseline</b>	<b>2,991</b>		
		9,880   +72%	Investment Income
		2,107   +15%	Discount Vector
		1,829   +13%	Residual
<b>1% Pop-Down</b>	<b>16,808</b>		

- (1) Investment income driver: The investment income early in the projection period is largely based on the assumed starting asset portfolio. After Year 5, when proceeds from the starting asset portfolio 5-year bond maturities are reinvested at lower rates under the 1% pop-down scenario set, the investment income diverges based on the projected yields. This divergence grows after Year 10 and after Year 20 when all assets from the starting asset

portfolio have matured. Lower investment income will result in greater asset shortfalls and a higher reserve.

- (2) Discount vector driver: For the SR, the discount rate is 105% of the path of one-year treasury rates for each projection year for each scenario reserve. The discount vector under the 1% pop-down scenario set for the CTE70 scenarios is on average 106 basis points lower than the baseline scenario set over the course of the projection period. As a result of the lower discount rates, the asset shortfalls are higher.

## VM-21

VM-21 was effective 1/1/2020 with a 3 year transition period. It was retroactively applied to variable annuities with and without GMDBs and with and without Variable Annuity Guaranteed Living Benefits (VAGLBs). VAGLBs contemplated by VM-21 include Guaranteed Minimum Accumulation Benefits (GMABs), hybrid and traditional Guaranteed Minimum Income Benefits (GMIBs), lifetime and non-lifetime Guaranteed Minimum Withdrawal Benefits (GMWBs), and Guaranteed Payout Annuity Floors (GPAF). Contracts not covered by VM-21 include modified guaranteed annuities covered explicitly under another NAIC regulation and contracts that guarantee an index and do not contain GMDBs or VAGLB.

Variable annuity reserves are generally more sensitive to changes in equities than interest rates because policyholders tend to allocate more of their separate account investments to equity funds than bond or money market funds. The VM-21 PBR approach reflects sensitivity to interest rate risks related to product features including GMIBs, GPAF, guaranteed minimum credited rates on general account investments, and the PV of GMDB and GMWBs.

The total reserve for VM-21 contracts is the SR plus any SPA plus any reserve calculated under the Alternative Methodology. So, reserves are either determined as the SR plus the SPA (if any) or the reserve calculated under the Alternative Methodology (for eligible contracts and discussed below).

The SR is the CTE70 of stochastic scenario reserves. The reserve may be determined for a single model segment incorporating all VM-21 contracts (other than those using the Alternative Methodology) or using multiple model segments. The SR uses a greatest present value of accumulated deficiencies (GPVAD) approach where there is a floor of zero so scenarios with surpluses cannot offset scenarios with deficiencies. All appropriate cash flows are included in the calculation reflecting the product features of the group of contracts. This includes but is not limited to contract guarantees, benefit payments, general expenses, fund expenses, fees, reinsurance, revenue sharing, and any market value adjustment (MVA). It also includes all cash flows related to

hedges used to mitigate the risks of the guarantees, with the requirement that any future hedging strategy be reflected in the projections.

The MVA is a feature that adjusts the cash surrender value of the contract based on the change in interest rates from policy issue to the valuation date. This feature helps protect the company as rates change and shares in investment risk with the contract holder, in a sense. As interest rates go up, bond prices go down. The MVA reduces the contract's cash surrender value, subject to the non-forfeiture floor. Similarly as interest rates go down bond prices go up. The MVA increases the contract's cash surrender value.

Once cash flows are projected for each scenario, the GPVAD as of the valuation date is determined. The scenario reserve is then the starting assets used in the projection plus the GPVAD (essentially the greatest present value of asset shortfall to cover the liability cash flows in the projection) less the PIMR allocated to the contracts valued in the scenario reserve. This scenario reserve is then subject to an aggregate cash surrender floor for the policies in the grouping used to calculate the scenario reserve. In formula form:

$$\text{Scenario reserve} = \max [(\text{starting asset amount} + \text{GPVAD} - \text{allocated PIMR}), \text{aggregate cash surrender value}]$$

Starting assets used to start the GPVAD projections should be equal to the approximate statutory reserve and consists of all separate account assets and hedge instruments, and enough general account assets plus allocated PIMR to cover the balance of the estimated statutory reserve.

Alternatively, the scenario reserve can be calculated by the direct iteration method, where starting assets are iterated until all projected benefits and expenses are covered, i.e., there are no accumulated deficiencies. The reserve is equal to the starting assets, subject to the cash surrender value floor.

Asset cash flow projections for both the general account and the separate account should be appropriately modeled reflecting expected cash flows for each asset as well as projecting gross investment returns, and realized and unrealized capital gains/losses consistent with the scenario being modeled.

The projection period must be long enough that the resulting reserve would not be materially larger due to the inclusion of a longer time period. What this will generally mean is that liability cash flows are run to a point where they are no longer material.

The SR is subject to an SPA floor. The SPA, as noted above, is not calculated for policies following the Alternative Methodology. It is a reserve adjustment with prescribed assumptions replacing company assumptions along with a couple of other adjustments recalculating the reserves without future hedges except for index credits. Its main purpose is to establish a reserve level for comparison with company calculated reserves. If the SPA is greater than 0, then that amount is added to the SR to determine the SPA "reserve." It does not create a safe harbor (if company reserves are larger, they must be held).

Contracts eligible for the Alternative Methodology have either no guaranteed benefits or, at most, GMDBs. If the company uses the SR/SPA approach to value policies that otherwise qualify for the Alternative Methodology, they can only switch to the Alternative Methodology with domiciliary commissioner permission.

The reserve under the Alternative Methodology for contracts with GMDBs is the seriatim cash surrender value plus a factor applied to each contract. The reserve before application of floors can be less than the cash surrender value due to a negative factor. The reserve is then floored at the larger of the cash surrender value and the CARVM reserve. If there are no GMDBs then the reserve is the CARVM reserve.

VM-21 also describes considerations in setting policyholder behavior assumptions and setting a prudent estimate mortality assumption, including reflection of efficiency in policyholder behavior (similar to the discussion in the VM-22 section). Details are beyond the scope of this paper.

Appropriate sensitivity tests also must be performed and documented. The sensitivity tests should cover key assumptions, including policyholder behavior assumptions. The results of the tests should be used by the actuary to determine if calculated reserves are set at an appropriate level.

## VM-22

VM-22 is the latest addition to model-based reserving for US life and annuity products. VM-22 is effective for 1/1/2026 and later issues with a three year transition period. All prospective business must be valued under PBR beginning with 1/1/2029 issues. During the transition period, companies can choose to value contracts on a PBR basis block by block. Once the company values the business under VM-22, it must continue to do so. The basic framework for VM-22 is VM-21, with appropriate modifications for fixed annuities and there are also some VM-20 elements in VM-22.

An issue still under discussion is whether VM-22 is to be retroactive, retroactive to what date and whether and how retroactive adoption will be optional at the company's discretion or whether adoption is mandatory. Retroactivity is beyond the scope of this paper.

VM-22 covers fixed annuity products such as fixed deferred annuities (FA's), fixed indexed annuities (FIA's), payout annuities (PA's), group annuities such as under pension risk transfer (PRT), and longevity reinsurance.

There are three reserving categories: Payout Annuities, Longevity Reinsurance and Accumulation. Payout contains contracts like PA and PRT. Longevity Reinsurance includes contracts transferring longevity (mortality) risk from one company to another and Accumulation covers all other contracts, such as FIA and FA. Reserves are calculated within each reserving category. However, currently aggregation is permitted between the Payout and Accumulation category if both groups manage risks together and are backed by the same asset portfolio or portfolios following the same asset liability management (ALM) strategy. Some details on this cross-category aggregation are also a day 2 item, currently under exposure and discussion.

The main reserve under VM-22 is the SR<sup>8</sup>. There are exclusion tests, which will be described below. There is also a DR, subject to a single scenario test. So VM-22 starts with the requirement to calculate the SR, unless an exclusion test is met. If the exclusion test is met, then reserve calculations follow the old formulaic methods unless the block of business qualifies for the DR. As noted above, VM-20 requires calculating the SR, DR and NPR unless the relevant exclusion tests are met.

In determining a final SR amount, the CTE70 reserve calculated using PBR assumptions is increased by a hedging error factor multiplied by the difference between CTE70 reserves calculated without future hedges except interest credits, and the CTE70 reserve using PBR assumptions, if positive. The error factor varies between 5% and 100% and will vary based on the sophistication of the hedge modeling and formal back testing of the model. In other words, there is some level of modeled hedge ineffectiveness that must be accounted for in the final SR.

For any block of policies required to calculate the DR or SR, the SPA must be calculated. The SPA is a disclosure only item currently. It is a reserve adjustment (either an SR or DR structure consistent with how the block is valued) with prescribed assumptions replacing company assumptions along with a couple of other adjustments including recalculating the reserves without future hedges except for index credits. Its main purpose is to establish a reserve level for comparison with company calculated reserves. If the SPA is greater than 0, then that amount is added to the SR or DR to determine the SPA "reserve." It does not create a safe harbor (if company reserves are larger, they must be held).

If the SPA is greater than 0, then disclosures in the PBR report under VM-31 are required. While there are day 2 details to work out, an attribution analysis between the company reserve and the SPA is required. In addition, the VM-31 report must justify the reason reserves are not strengthened when an SPA is greater than 0, and that justification must be based on company assumptions that "can be supported based on reliable, relevant and credible company data." In other words, credible company assumptions result in a lower reserve than the SPA implies so there is no need for reserve strengthening.

The SR exclusion tests, like VM-20, consist of a SERT, a Demonstration test and a Certification Method. The SERT also uses 6% as the pass/fail point, however 47 scenario reserves instead of 15 are compared to the baseline. That is because the 16 scenarios (same as VM-20 scenarios) have two additional sets of results, one set assuming +1% (per year from the valuation date to the projection year) future mortality improvement and the other assuming -1% future mortality improvement.

The Demonstration test, like VM-20 requires the same periodic determination; the test is passed if the formulaic CARVM reserve is larger than the SR calculated for the block subject to the Demonstration test.

The Certification method indicates passage of one of the other tests within the last 3 years, with no material changes in interest rate risk, mortality/longevity risk, and asset return volatility risk. VM-22

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<sup>8</sup> this paper uses the same acronyms in some cases rather than coming up with new ones; the reader should interpret the acronym as referring to the calculations required under the VM chapter being discussed.

also allows a direct certification in year one of implementation and every 3 years thereafter, for contracts without guaranteed living benefits (GLB), future hedging strategies and is not PRT business, based on not being materially subject to the risks described above. This alternative certification does require having documentation available backing up the certification.

As noted above, the DR is a required comparative calculation in VM-20. In VM-22, it is an *alternative* calculation. The DR is meant to come into play when the tail (CTE70) scenario reserves calculated do not vary much from each other or the DR due to a lack of interest rate sensitivity or for any other reason, because cash flows are not influenced by these factors. As a result, an appropriate reserve can be calculated using a single scenario rather than going through the process of running many scenarios to get a very similar value.

In order to calculate the DR, the block of policies must pass the Single Scenario Test (SST). The SST requires that the block of policies have predictable, stable cash flows, limited policyholder behavior tied to economic conditions or changes in interest rates and also pass a version of an exclusion test. It is expected that contracts with surrender benefits, recurring premium payment and GLB's are unlikely to pass the SST.

The SST exclusion tests are very similar to the regular exclusion tests. The SST SERT uses only the 16 no mortality improvement scenarios with the same structure and 6% pass level. The Demonstration test requires comparing the SR with the DR rather than the formulaic CARVM reserve. The Certification method requires a quantitative demonstration as part of the certification.

Scenario reserve calculations are structured similarly to VM-20. The scenario reserve is the starting asset amount plus the GPVAD, which is the same method used in VM-20, despite slightly different language.

There is also an alternative method to determine the scenario reserve. It is a direct iteration method where starting assets are iterated until all projected benefits and expenses are covered, i.e., there are no accumulated deficiencies.

Projected cash flow items include premium, other fees and charges, revenue sharing income, death claims, surrender and withdrawal benefits, other guarantees, NGE, expenses, reinsurance and hedges. Invested asset cash flows consist of investment income as well as realized gains/losses and reflect default costs, investment expenses, prepayments and any asset sales. Like VM-20, VM-22 has a reinvestment guardrail. The reinvestment assumption will be the company's assumption or guardrail, whichever results in the higher reserve.

Projected MVA is also included in the cash flows if this is a feature of the contract. The MVA is a feature that adjusts the cash surrender value of the contract based on the change in interest rates from policy issue to the valuation date. This feature helps protect the company as rates change and shares in investment risk with the contract holder, in a sense. As interest rates go up, bond prices go down. The MVA reduces the contract's cash surrender value, subject to the non-forfeiture floor. Similarly as interest rates go down bond prices go up. The MVA increases the contract's cash surrender value.

Other cash flows that may be relevant for VM-22 products include projected annuitization benefits from settlement options or election of GMIB or GMWB). Under the SPA, once a product with a

GMIB or GMWB no longer has any account value, the contract is assumed to stay in force, i.e., there is no assumed lapse at that point.

In general PBR requires assuming efficient (although not necessarily perfect) policyholder behavior. For example, in the moneyness (ITM) of benefits need to be addressed. The more in the money the guaranteed benefit, the lower lapses are expected to be. For example, VM-22 considers ITM in the SPA for GMWB's and similar living benefits by comparing the guaranteed actuarial present value (GAPV) of the benefit stream to the contract's account value. To the extent the GAPV is increasingly larger than the account value, the expectation is that the contract holder will place more value on the GLWB benefits and will be reluctant to lapse their policy. While SPA prescribed assumptions are not required for the SR, they should be considered as deemed appropriate. For example, should there be an expectation of lapse when there is a guaranteed living benefit and no account value?

As the cash surrender value floor is applied to the NPR in VM-20 and there is no NPR in VM-22, the aggregate cash surrender floor is applied to each scenario reserve (or the scenario reserve for the DR) for that group of contracts. Additionally, if a contract has a market value adjustment (MVA) feature and all assets supporting the block are held at market value, then MVA on the valuation date is applied to the aggregate cash surrender value.

Similarly to the DR under VM-20, there is no NAER needed for the direct iteration method. For the GPVAD method, the discount rate will be the NAER on the additional invested asset portfolio. This additional asset portfolio represents general account assets that are needed in a scenario reserve to cover any accumulated deficiencies. Assets should be selected in such a way that the scenario would not accumulate accumulated deficiencies. The additional assets can be a pro-rata slice of the starting assets, cash or additional general account assets assigned to the PBR calculation. If PBR is calculated for other products, say under VM-21, the same assets cannot be used in both places. For example, if a particular cusip is used in its entirety under VM-21, it cannot also be used for VM-22.

The additional invested asset portfolio is projected out, where investment cash flows are reinvested using the applicable reinvestment assumption or guardrail, defaults and investment expenses. No liabilities are projected. The NAER is the vector of annual earned rates for each scenario reserve that replicates the growth of the additional invested asset portfolio from period to period over the projection.

## VM-22 Example

This is an example of a day one<sup>9</sup> reserve calculation for a fixed deferred annuity with a GLWB. The product design is, like the ULSG example above, typical of products available in the market.

Reserves were run under the 9/30/2025 GOES scenario set, along with a 1% parallel shift up (1% pop-up), and a 1% parallel shift down (1% pop-down) of the 9/30/2025 GOES scenario set.

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<sup>9</sup> Assets are purchased at time zero and the reserves are calculated the next day.

## Product Design/Details

The fixed rate deferred annuity was designed with a 7-year surrender charge schedule (9% to 3% grading linearly), a 10% free withdrawal provision, and fixed crediting rates based on the portfolio net earned rate minus a 100 basis points spread.

The GLWB rider was designed with a 10-year rollup with 12% compound interest and a 110 basis points fee based off of the guaranteed benefit base. Payout factors when lifetime withdrawals are activated start at 4.0% at attained age 60 and increase by 10 basis points for every year thereafter.

## Liability Assumptions and Margins

The best estimate GLWB utilization mix is 30% activate after 5 years; 65% activate after 10 years; and 5% never utilize. The margin on the utilization best estimate shifts the 5% from the never utilize bucket to activate after 10 years.

Withdrawals before utilization assumed to be 1.15% / 1.65% based on attained age. Withdrawals after utilization are assumed to be 100% of the available guaranteed lifetime withdrawal amount.

Surrenders assumptions used are from VM-22 Section 6.C.5 detailed below.

Table 6.6: Base Lapse Rates for Indexed Annuities and Fixed Annuities with Guaranteed Living Benefits

Years Before or After Surrender Charge Expiration	Attained Age			
	Before 60	60 to 69	70 to 79	80 and above
5 yrs or more after expiry	11.5%	6.5%	4.5%	4.0%
4 yrs after expiry	11.5%	6.5%	4.5%	4.0%
3 yrs after expiry	11.5%	6.5%	4.5%	4.0%
2 yrs after expiry	11.5%	6.5%	4.5%	4.0%
1 yr after expiry	11.5%	6.5%	4.5%	4.0%
Upon expiry	18.5%	14.0%	11.0%	8.5%
1 yr to expiry	7.0%	4.5%	4.5%	3.5%
2 yrs to expiry	3.0%	2.5%	2.0%	2.5%
3 yrs to expiry	2.5%	1.5%	2.0%	2.5%
4 yrs to expiry	2.0%	1.5%	1.5%	2.0%
5 yrs or more to expiry	2.0%	1.5%	1.5%	1.5%

The dynamic surrender adjustment assumptions uses the SPA dynamic lapse formula and is as follows:

$$\text{Total Lapse} = (\text{Base Lapse} \times \text{GMIR Factor} + \text{Rate Factor} \times \text{MVA Factor}) \times \text{ITM Factor}$$

where:

ITM Factor

$$\text{ITM Factor} = (0.75 \div \text{ITM})^2 \text{ if } \text{ITM} < 0.75 \text{ and } \text{AV} \neq 0$$

$$\text{ITM Factor} = 1 \text{ if } 0.75 \leq \text{ITM} \leq 1.25 \text{ and } \text{AV} \neq 0$$

$ITM\ Factor = (1.25 \div ITM)^2$  if  $ITM > 1.25$  and  $AV \neq 0$

$ITM\ Factor = 0$  if  $AV = 0$

$ITM = GAPV \div Account\ Value$

Rate Factor

$Rate\ Factor = Market\ Factor \times Max(0, 1 - 5 \times (1 - CSV/AV))$

MVA Factor

$MVA\ Factor = 0$  when MVA is in effect; 1 when MVA is not in effect

GMIR Factor

For indexed annuities:

$GMIR\ Factor = 1.00$

For fixed annuities:

$GMIR\ Factor = 1.25$  if  $GMIR \leq 1.0\%$

$GMIR\ Factor = 1.00$  if  $1.0\% < GMIR \leq 2.5\%$

$GMIR\ Factor = 0.70$  if  $GMIR > 2.5\%$

Market Factor

$Market\ Factor = -1.25 \times (CR - MR)X$  if  $CR \geq MR$

$Market\ Factor = 0$  if  $MR > CR \geq (MR - BF)$

$Market\ Factor = 1.25 \times (MR - BF - CR)X$  if  $CR < (MR - BF)$

$X = 2.0$  during Surrender Charge Period, 2.5 at Shock, and 2.5 thereafter  
Minimum and Maximum Lapse (not applicable if  $AV = 0$ )

$Minimum\ Lapse = 0.5\%$

$Maximum\ Lapse = 90\%$

Crediting Rate (CR)

For fixed annuities:

$CR =$  the crediting rate, at the time of the projection

Market Rate (MR)

$MR =$  the market competitor rate at the time of the projection

For fixed annuities with Interest Guarantee Period  $\geq 2$  Years:

$MR =$  N-year Treasury rate plus 50% A / 50% AA spread minus Pricing Spread

$N =$  5-year Treasury rate for 2 years  $\leq$  Interest Guarantee Period  $< 5$  years

$N =$  7-year Treasury rate for 5 years  $\leq$  Interest Guarantee Period  $< 7$  years

$N =$  10-year Treasury rate for Interest Guarantee Period  $\geq 7$  years

Pricing Spread = 0% (since already reflected in selection of credit spread)

Buffer Factor (BF)

$BF =$  a buffer factor where dynamic lapses do not occur, 50bps

Maintenance expenses assumed are \$150 per policy per year with inflation tied to one-half the emerging 5-year treasury rate.

The commission rate did not impact the results as they would be incurred when the premium was received, technically prior to the valuation.

Mortality assumptions are 80% of 2012 IAM Basic Table with Projection Scale G2 mortality improvement.

## Asset Assumptions

The initial asset portfolio is assumed to be a mix of BBB corporate bonds with semi-annual coupons. The maturities (weightings) are 5-year (20%), 10-year (40%), and 20-year (20%). The gross yields are assumed to be 5.50% / 5.75% / 6.00% respectively. Net yields are determined from the gross yields minus VM-20 prescribed defaults and minus an assumed 25bps investment expense.

The reinvestment asset assumption follows the VM-22 reinvestment guardrail, 5% Treasuries, 15% AA and 80% A corporate bonds with semi-annual coupons. The assumed reinvestment maturities (weightings) are 5-year (33.33%), 10-year (33.33%), and 20-year (33.33%). Gross yields are determined from the treasury yields within each scenario reserve projection plus VM-20 prescribed spreads minus VM-20 prescribed defaults minus an assumed 25bps investment expense. The prescribed spreads grade from the investment grade current benchmark spreads in projection year 1 to the investment grade long-term benchmark spreads over 4 years.

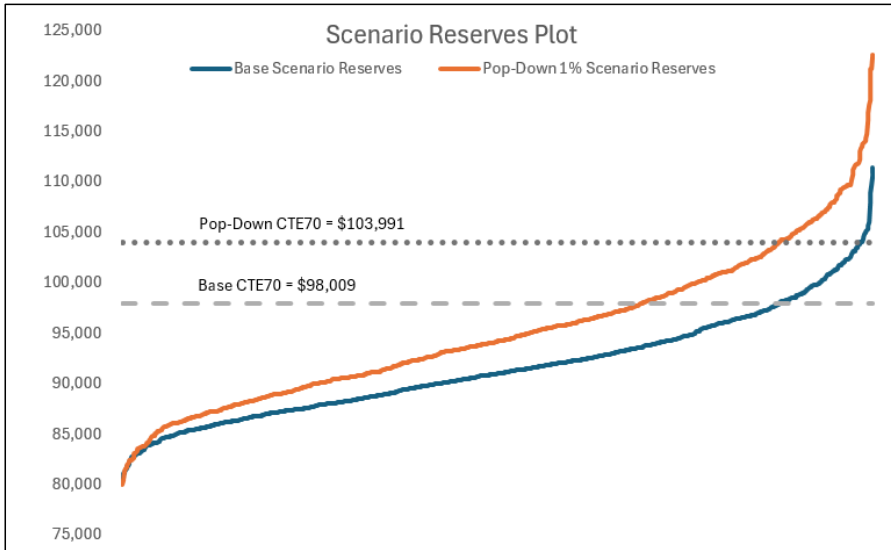
## Results

The results for modeled ages 55, 65, and 75 are shown below along with a shorter duration reinvestment assumption using the modeled age 65.

	Stochastic Reserves UNFLOORED CTE70			
	9/30/25 GOES	1% Pop-Down	1% Pop-Up	Diff Pop-Down vs Base / Pop-Up vs Base
55 Year Old Cell	93,476	101,398	89,173	+8.5% / -4.6%
65 Year Old Cell	98,009	103,991	93,859	+6.1% / -4.2%
75 Year Old Cell	90,728	91,251	90,499	+0.6% / -0.3%
65 YO Cell; Shorter Reinv <sup>10</sup>	99,481	105,900	94,794	+6.5% / -4.7%

The 65 year old baseline and pop-down scenarios reserves are depicted below.

<sup>10</sup> Shorter reinvestment assumption is 50% 5-year; 35% 10-year; 15% 20-year



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## Attribution Analysis

An attribution analysis was performed for the age 65 cell between the baseline and the 1% pop-down scenario to determine the interest rate sensitivity in the stochastic reserve, ignoring any cash surrender value floor. The key interest rate sensitive drivers identified are (1) the discount vector, (2) investment income, and (3) withdrawals.

	Stochastic Reserves UNFLOORED CTE70	Attribution Impact	Attribution Step
<b>Baseline</b>	<b>98,009</b>		
		3,331   +56%	Discount Vector
		1,963   +33%	Investment Income
		691   +12%	Withdrawals
		(4)   0%	Residual
<b>1% Pop-Down</b>	<b>103,991</b>		

- (1) Discount vector driver: In these model runs, the additional invested asset portfolio is assumed to be cash immediately invested as of the valuation date using the assumed reinvestment strategy. The vector of annual earned rates that replicates the growth in this additional asset portfolio which is the basis for discounting the surplus is interest sensitive and directly impacted by projected yields. The NAER vector under the 1% pop-down scenario set for the CTE70 scenarios is on average 96 basis points lower than the baseline scenario set over the course of the projection period. As a result of the lower discount rates, the GPVADs are higher.
- (2) Investment income driver: The investment income early in the projection period is largely based on the assumed starting asset portfolio. After Year 5, when proceeds from the starting asset portfolio 5-year bond maturities are reinvested at lower rates under the 1% pop-down scenario set, the investment income diverges based on the projected yields. This divergence grows after Year 10 and after Year 20 when all assets from the starting asset portfolio have matured. Lower investment income will result in greater accumulated deficiencies and a higher reserve.
- (3) Withdrawals impact: Projected interest rates will impact policyholder behavior. Competitor rates in the 1% pop-down scenario set are lower, which results in reduced lapses in the dynamic lapse formula. This in turn results in increased exposure to living benefit withdrawals leading to greater accumulated deficiencies and a higher reserve.

## Asset Adequacy Testing

At the end of each year, the appointed actuary must provide a Statement of Actuarial Opinion (SAO). While reserves are calculated every month or quarter, AAT is an additional step to ensure the overall level of reserves are adequate. So, one way to think about US statutory reserving is that PBR's model based and transparent approach results in a conservative reserve covering the material risk, including interest rate risk, of the blocks covered. CFT serves to cover PBR and non-PBR blocks, tested in aggregate at a legal entity level, with an additional layer of testing to determine appropriately conservative reserving levels reflecting interest rate risk as well as any other material risks.

As noted above and to be discussed further, this paper will focus on interest sensitive blocks and CFT, as opposed to other asset adequacy testing methods, which are generally not appropriate for interest sensitive blocks. The description of the products, the assets and reserves tested, the analysis, results and conclusions are documented in an actuarial memorandum that is submitted with the SAO.

CFT is designed to cover interest rate risk (equity risk if applicable) as well as all other material risks related to the products tested. From an interest rate risk perspective, the appointed actuary is expected to consider a wide range of interest rate scenarios. The testing must be conducted in Moderately Adverse Conditions. Actuarial Standard of Practice 22 (ASOP 22) defines Moderately Adverse Conditions as "*Conditions that include one or more unfavorable, but not extreme, events that have a reasonable probability of occurring during the testing period.*" This is generally considered to be, roughly speaking, a CTE70 or 85<sup>th</sup> percentile evaluation of reserves. Required capital (actually multiples of that amount) are held by companies to cover risks that are "deeper in the tail" and will be discussed below.

Many companies use scenarios described in New York regulations (NY 7) for AAT<sup>11</sup>. They are:

1. level with no deviation;
2. uniformly increasing over 10 years at a half percent (0.5%) per year and then level;
3. uniformly increasing at one percent per year over five years and then uniformly decreasing at one percent per year to the original level at the end of the 10 years and then level;
4. an immediate increase of three percent and then level;
5. uniformly decreasing over 10 years at a half percent (0.5%) per year and then level;
6. uniformly decreasing at one percent per year over five years and then uniformly increasing at one percent per year to the original level at the end of 10 years and then level; and
7. an immediate decrease of three percent and then level.

In scenarios 5, 6 and 7 the rates are floored at either half their initial level or their initial level minus ½ the initial 5 year treasury rate.

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<sup>11</sup> 11 CRR-NY §95.10(d)(1)

Some actuaries will supplement these scenarios with other deterministic scenarios, test stochastic scenarios, or test both deterministic and stochastic scenarios or test other scenarios than the NY 7. The overarching consideration is that the distribution of interest rates in moderately adverse conditions are used to test the blocks covered by CFT for asset adequacy. Under a wide range of interest rates there must be sufficient cash flows (from premiums, investment income, fees, reinsurance allowances, etc.) to cover benefit payments and expenses as they come due, over the projection period. For example, interest rate scenarios should reflect treasury rates at today's levels as well as above and below those levels.

Reinvestment assumptions should use appropriately conservative spreads to treasuries, relevant default charges as well as investment expenses that reflect expenses charged on the pool of assets over the projection period. In the case of investment expenses, an overall cost (in bps) may not be appropriate over the projection period if, say, higher yielding, more complex assets with higher investment expense charges come to dominate a scenario over time. Developing expenses that vary by asset class, would avoid this problem to a large extent.

While there is not a specific requirement to apply an explicit margin to all assumptions, key assumptions should have added on conservatism. Conservatism should be reflected in the CFT baseline runs and not through sensitivity tests.

The scenarios tested must use an appropriate allocated amount of Interest Maintenance Reserve (IMR). Any admitted negative IMR must be fully allocated and used to reduce the amount of starting assets used in the projections.

The actuary will also establish criteria for determining that asset adequacy reserves are required. For example, the criteria might be to pass ( meaning there are no ending surplus deficiencies and there are at most small, temporary interim deficiencies) 5 out of the 7 NY7. Both book and market value of assets are considered in the criteria.

Assets and liabilities are projected out to a point where there is no or an immaterial amount of liabilities remaining. This is to ensure there are no material deficiencies being ignored. For example, if the projection period was 20 years, however 60% of the block was still in force at that time, this would raise the question of whether the projection period was long enough. The projection period clearly would not be long enough if there were material deficiencies in projection years 25 – 35.

Another important consideration is sensitivity testing. Key assumptions should be tested and the appointed actuary should discuss in the actuarial memorandum how those sensitivity tests were used or not used to influence their determination on whether an asset adequacy reserve is required or not. Sensitivity tests related to interest rate risk may include adjustments to asset yields through reduced reinvestment spreads, higher default rates and higher lapse rates due to higher interest rates and the resulting disintermediation risk.

In recent years two new actuarial guidelines (actuarial guidelines are used to interpret and provide details on regulations as practice evolves and new information becomes available) impacting AAT have been introduced. The first one is Actuarial Guideline LIII – Application of the Valuation Manual for Testing the Adequacy of Life Insurance Reserves (AG53). AG53 requires identification of asset groups used in cash flow testing that have a spread over US Treasuries that is larger than AG53

defined spreads (called Guideline Excess Spreads or GES). AG53 also requires attribution of GES into appropriate risk components including the portion of excess spread due to interest rate risk. AG53 further requires sensitivity tests that reduced the GES to zero, meaning modeled spreads over Treasury are not larger than the AG53 spreads. AG53 does not mandate holding additional reserves, however the tests do create additional data points for the appointed actuary to consider in forming their opinion on the need for any additional asset adequacy reserve.

Actuarial Guideline LV – Application of the Valuation Manual for Testing the Adequacy of Reserves Related to Certain Life Reinsurance Treaties (AG55), is effective for year-end 2025. Generally speaking, actuaries have traditionally evaluated reinsurers’ collectability risk. If there were indications of strong claims paying ability (solid ratings, history of paying the cedant on time and in full, etc.), many actuaries would make that assumption in CFT. If by assuming there was a sound reinsurance asset, no asset adequacy reserves were required, then the appointed actuary could conclude that reserves were adequate on all direct written business. AG55 requires more direct cash flow testing of assets backing reinsured business as well as recognizing any material differences between statutory reserve credits and reserves held by the reinsurer to back the business. AG55 testing applies to Asset Intensive Reinsurance Transactions which is defined as *“Coinsurance arrangements involving life insurance products that transfer significant, inherent investment risk including credit quality, reinvestment, or disintermediation risk as determined by Appendix A-791 of the Life and Health Reinsurance Agreements Model Regulation.”*<sup>12</sup>

Similar to AG53, AG55 tests that must be run result in new data points for the appointed actuary to consider in forming their opinion. Officially both AG53 and AG55 are disclosure only; as noted previously the appointed actuary should consider all available and relevant information in forming their opinion.

## Asset/Liability Management

Making sure that expected asset cash flows line up well with expected payments of benefits and expenses is an important component of sound insurance company management. While assets and liabilities do not have to be perfectly matched, they should be reasonably so. ALM is typically thought of in terms of matching duration. For more sophisticated approaches, convexity is also considered. Tight asset/liability matching tends to lower reserve requirements and makes reserves less sensitive to interest rate fluctuations, while greater mismatches tend to lead to higher reserves and increased sensitivity to interest rate changes.

Because PBR includes both asset and liability cash flows, asset/liability mismatches will increase reserves. As a result, companies reduce risk by maintaining strong ALM programs and managing tight asset and liability duration and convexity.

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<sup>12</sup> AG55 3.B

A key component of AAT is ALM. Some of the origins of AAT trace back to company insolvencies at least partially related to ALM mismatches. Mismatches in CFT are reflected in either reduced surpluses or perhaps larger deficiencies. Take the example of performing CFT on a multi-year guaranteed fixed deferred annuity block. Both low and high interest rate environments would be part of the testing. In rising rate environments, lapse rates will tend to rise as policyholders turn in their lower credited rate products to purchase a higher credited rate competitor product. Overall profitability will tend to be lower as assets earning a spread for the company must be sold (asset adequacy testing does not allow recognizing new business, so there would be no new cash that can cover surrenders). Assets, like bonds, will incur market value losses compounding the negative impact of the higher rate environment. From an ALM perspective, the liability duration decreased relative to the asset duration. The impacts are reduced if assets and liabilities were well matched prior to the increase in interest rates. If there was already a significant mismatch, say, asset durations are much longer than liability durations, results are magnified. Product features also come into play as the presence of the MVA can reduce company interest rate risk, as long as the MVA formula moves in reasonable lock step with asset market value changes.

The opposite impact can occur when interest rates decline. People will tend to hold onto their contracts longer as better credited rates are not available elsewhere. Liability durations will extend. With shorter asset durations, companies will need to reinvest in a lower rate environment, also either reducing surpluses or increases in deficiencies.

For the ULSG example, in the table below, the baseline asset and liability durations are X and Y, respectively, resulting in a Z year mismatch. The issue age 65 example uses a shorter reinvestment duration. The asset and liability durations are A and B, respectively, resulting in a C year mismatch. The mismatch alone results in a reserve increase.

Commented [BF4]: Values being calculated.

	Stochastic Reserves UNFLOORED CTE70			
	9/30/25 GOES	1% Pop-Down	1% Pop-Up	Diff (\$) Pop-Down vs Base / Pop-Up vs Base
65 Year Old Cell Baseline Reinvestment Duration (33% 5yr; 33% 10yr; 33% 20yr)	2,991	16,808	0	13,816 / -2,991
65 Year Old Cell Shorter Reinvestment Duration (50% 5yr; 35% 10yr; 15% 20yr)	6,575	21,892	89	15,317 / -6,486

For the deferred annuity example, in the table below, the baseline asset and liability durations are X and Y, respectively, resulting in a Z year mismatch. The issue age 65 example uses a shorter reinvestment duration. The asset and liability durations are A and B, respectively, resulting in a C year mismatch. The greater misalignment of assets and liabilities results in a reserve increase.

Commented [BF5]: Values being calculated.

	Stochastic Reserves UNFLOORED CTE70

	9/30/25 GOES	1% Pop-Down	1% Pop-Up	Diff Pop-Down vs Base / Pop-Up vs Base
65 Year Old Cell Baseline Reinvestment Duration (33% 5yr; 33% 10yr; 33% 20yr)	98,009	103,991	93,859	+6.1% / -4.2%
65 Year Old Cell Shorter Reinvestment Duration (50% 5yr; 35% 10yr; 15% 20yr)	99,481	105,900	94,794	+6.5% / -4.7%

## Interest Rate Risk Under RBC, including C3P1 and C3P2

Required capital for interest rate risk (C-3) is calculated on page LR027 of the RBC life report. LR027 includes both a factor method as well as cash flow modeling for certain products. RBC must be calculated and reported annually, although best practice is to project RBC throughout the year to better manage capital positions.

For the factor based portion of C-3, products are split up into low, medium and high risk categories. As risk increases so do the factors and the resulting required capital charges. For example, a fixed deferred annuity with MVA is classified as low risk due to the MVA (sharing of investment risk with the contract holder). Similarly, single premium whole life is also considered to be low risk as the product is heavily funded and consequently has a low net amount at risk.

On the other hand, a deferred annuity contract without an MVA and with surrender charges less than 5% has a lower barrier to exit, making the policyholder surrender option more valuable and more likely to work against the insurer's interest in keeping the contract in force. As a result, those contracts are considered high risk and have a higher required capital charge.

Additionally, certain products undergo cash flow modeling. There is C-3 phase 1 modeling (C3P1) and C-3 phase 2 modeling (C3P2). The results of C3P1 or C3P2 can either increase or decrease required C-3 capital.

C3P1 covers fixed deferred annuities and single premium life insurance as well as immediate annuities, structured settlements and guaranteed investment contracts. The company's CFT models should be used with all the same assets (except the asset valuation reserve, AVR) and assumptions, however a different scenario set must be used and the results are measured differently. There is a 50 scenario set that can be used, which is a subset of the most extreme scenarios from a larger 200 scenario set. Alternatively, companies can use a smaller 12 scenario

set, however it is more conservative. For each scenario, statutory surplus for each calendar year is present valued to the valuation date using 105% of the after tax one year treasury rates for that scenario. The most negative of the present value of surplus for each scenario is that scenario's C-3 measure. The scenario specific C-3 measures are ranked in descending order, from the largest capital need to the smallest. For the 50 scenario set the 5<sup>th</sup> through 17<sup>th</sup> largest scenarios are each weighted by prescribed weights. The weighted average of these scenarios grossed up to a pre-tax basis is the C3P1 amount. For the 12 scenario set, The C3P1 amount is  $\max[1/2 \times \text{the largest capital requirement; average of the 2nd and 3rd largest capital requirement}]$  grossed up to a pre tax amount.

C3P2 covers variable annuities. C3P2 is calculated differently for contracts that calculate reserves under the VM-21 Alternative Methodology and those that calculate the SR/SPA. Calculate CTE98 for the SR/SPA contracts. Federal income tax must also be reflected in the calculations and there are two methods that can be used. Depending on the tax method chosen, C3P2 is either:

- 1)  $25\% \times ((\text{CTE98} + \text{SPA} - \text{Statutory Reserve}) \times (1 - \text{Federal Income Tax Rate}) - (\text{Statutory Reserve} - \text{Tax Reserve}) \times \text{Federal Income Tax Rate})$ ; or
- 2)  $25\% \times (\text{CTE98} + \text{SPA} - \text{Statutory Reserve})$  - this method embeds tax into the projections used to calculate CTE98.

The total asset requirement (TAR) is the VM-21 reserve plus the amount above.

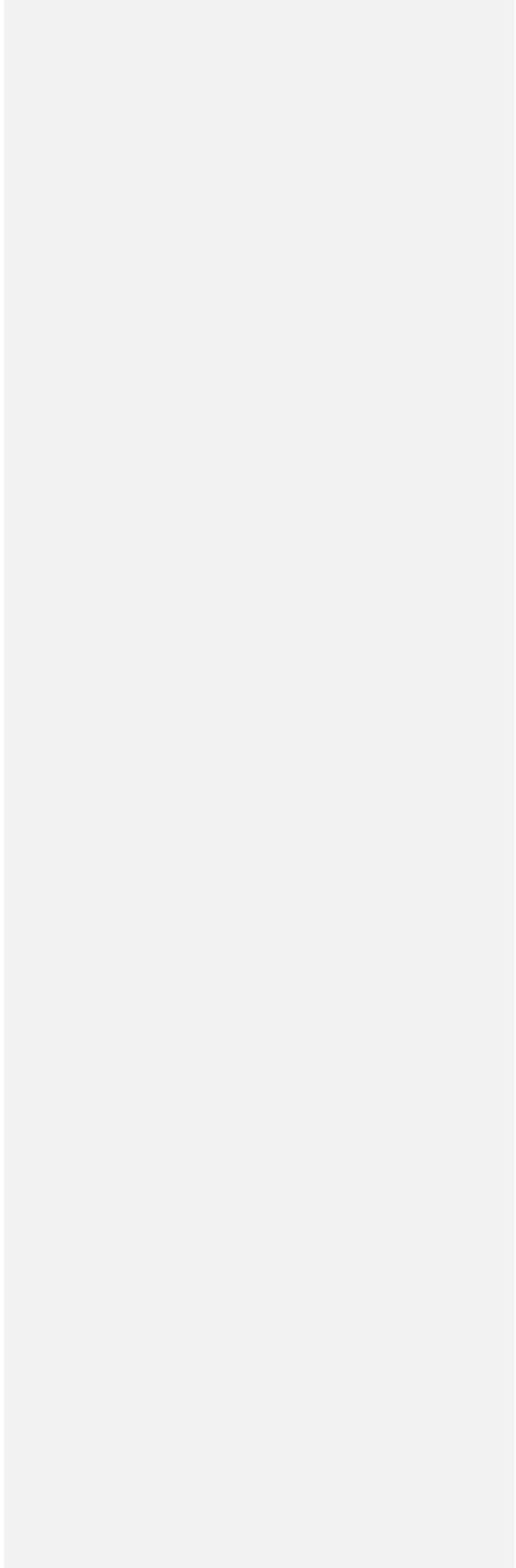
For Alternative Methodology contracts with GMDB, the TAR is the cash surrender value plus the Additional Asset Requirement (AAR). The AAR includes provision for amortization of outstanding surrender charges + provision for fixed dollar expenses net of fixed dollar revenue and provision for claims in excess of account value less spread based revenue. Once TAR is determined, the C3P2 component is TAR less the Alternative Methodology reserve under VM-21.

For variable annuities without guarantees, the C3P2 component is 11% of (fund balance less cash surrender value if the surrender charge is based on the fund balance); if the surrender charge is based on fund contributions, the C3P2 component is 2.4% of (fund balance less cash surrender value if the fund balance exceeds the sum of premiums less withdrawals) and 11% of (fund balance less cash surrender value if the fund balance does not exceed the sum of premiums less withdrawals). All results are multiplied by 79% to account for Federal Income Tax.

The C3P2 component for contracts with no cash surrender value and no performance guarantees is zero. C3P2 is the sum of the various C3P2 components described above.

As can be seen from the calculations above, interest sensitive contracts account for interest rate risk in determining required capital both from applications of factors as well as following either a PBR methodology using deep in the tail scenarios (C3P2) or using conservative scenarios (approximating the 95% percentile) in a CFT setting (C3P1).

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In addition to insight gained through the Aggregation Method, state regulators employ a range of additional tools to obtain insight into risks the insurance groups they supervise are exposed to and ensure that reasonable and effective mitigation measures are in place. Most notable among these is Own Risk and Solvency Assessment (ORSA), which is the insurance group's internal assessment of the sufficiency of capital resources to support relevant risks. The ORSA is required to be completed no less than annually, with more frequent updates if there are significant changes to the risk profile of the insurance group.

While the content of the ORSA is unique to each insurance group, the NAIC maintains an ORSA Guidance Manual that establishes minimum requirements for what must be included. Section 3 of the ORSA requires insurance groups to provide an assessment of group capital (current year with a comparison to the prior year) and prospective assessment of solvency under normal and stressed environments that demonstrates the group has the financial resources necessary to execute its multi-year business plan in accordance with its stated risk appetite. Stress testing scenarios are intended to be coherent and comprehensive, assessing all the underlying insurance companies' and group's key risk exposures. Stress scenarios will be informed by the risks that are relevant to the insurance group and cover a range of severities (e.g., cyclical, worst in history, acute vs prolonged shocks, etc.). For global life insurers market risk – and interest rate risk in particular – is key among the exposures assessed and discussed with their groupwide supervisor. Examples of potential shocks include:

- Interest rates decreasing or increasing with the severity being informed by the currency of the exposure and varying by tenor (e.g., impact at 10-year point vs 30-year) and target severity (e.g., cyclical, worst in history, etc.).
- Credit spread widening or tightening
- Equity market declines
- Currency appreciation or depreciation

While a statutory lens is foundational, others may also be relevant to the insurance group for executing its multi-year business plan (e.g., result through an internal economic model lens, U.S. GAAP lens, liquidity lens, etc.) and shared with state regulators as part of their oversight of the insurance group to ensure they have a fulsome understanding of risk exposures and how the insurer is managing them.

More broadly, state regulators have the authority to examine any insurer and its affiliates to ascertain the financial condition of the insurer, including the enterprise risk to the insurer

by the ultimate controlling party, or by any entity or combination of entities within the insurance holding company system, or by the insurance holding company system on a consolidated basis in order to determine its financial condition and if supervisory action or intervention is warranted. State regulators employ this authority proactively and meet on a regular basis with group management to receive updates on a range of topics that enable them to maintain a robust understanding of the financial strength of the insurance group and entities within it. Areas of regular focus and discussion include:

- Enterprise risk management – e.g., updates on risk exposures and risk appetite; how exposures are emerging and managed
- Capital and liquidity management – e.g., updates capital and liquidity position; impacts of market developments; forecasted results; rating agency views and developments; capital markets activities
- Investment portfolio management – e.g., update on investment holdings (asset classes, credit quality, etc.), performance, and strategy
- Financial reporting – e.g., updates on financial performance; discussions with internal and external auditors regarding their work

In addition to the examples noted above, state regulators also request and receive information on an adhoc basis when market conditions or developments warrant. Examples of situations include receiving updates on implications of volatility in financial markets on capital and liquidity (e.g., a spike in interest rates), investment portfolio developments (e.g., exposure to sectors / counterparties experiencing stress), etc.