Milliman Research Report

Prepared by:

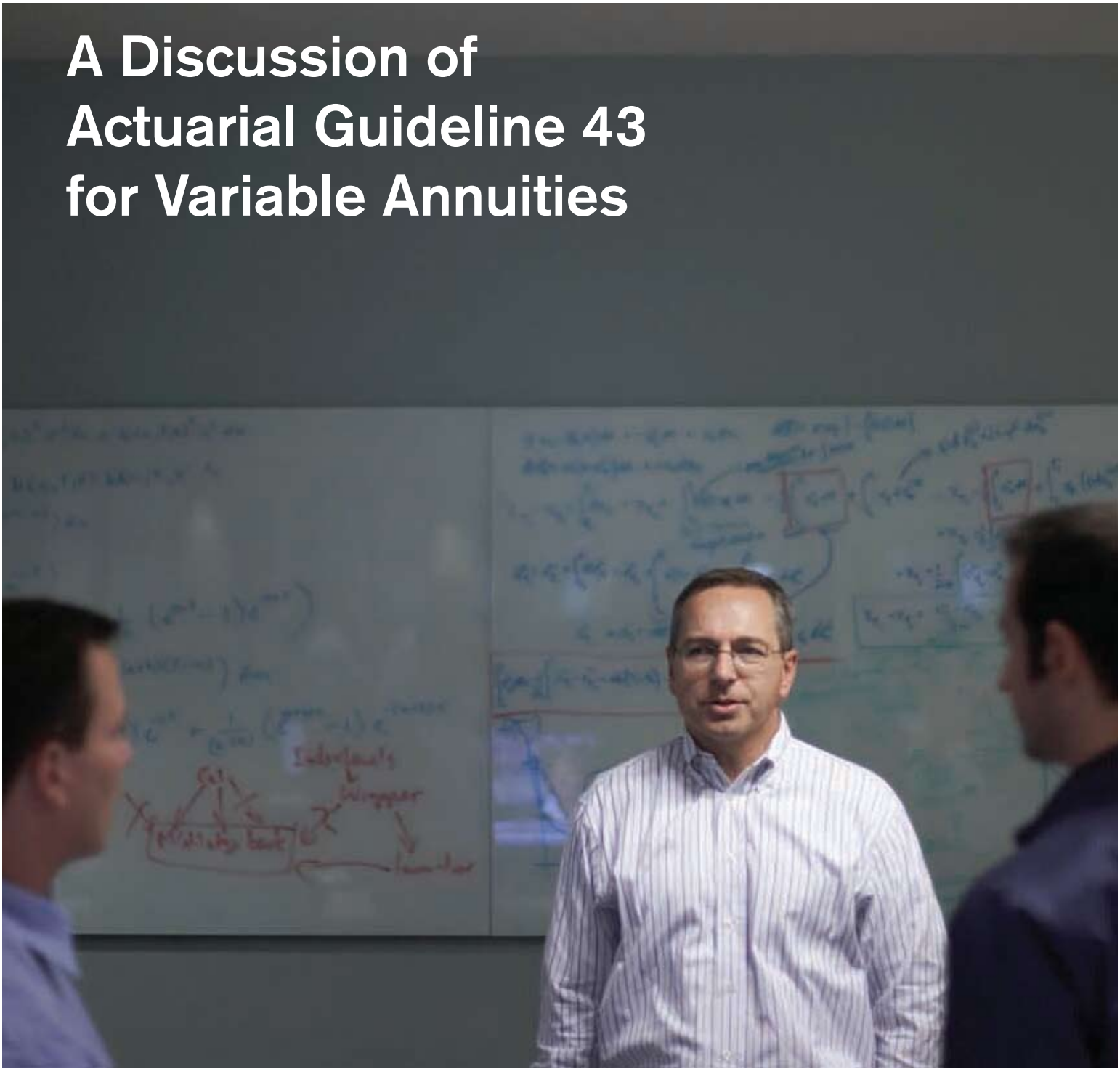
Novian Junus, FSA, MAAA

Zohair Motiwalla, FSA, MAAA

April 2009

Milliman

A Discussion of Actuarial Guideline 43 for Variable Annuities



Milliman, whose corporate offices are in Seattle, serves the full spectrum of business, financial, government, and union organizations. Founded in 1947 as Milliman & Robertson, the company has 49 offices in principal cities in the United States and worldwide. Milliman employs more than 2,100 people, including a professional staff of more than 1,100 qualified consultants and actuaries. The firm has consulting practices in employee benefits, healthcare, life insurance/ financial services, and property and casualty insurance. Milliman's employee benefits practice is a member of Abelica Global, an international organization of independent consulting firms serving clients around the globe. For further information visit www.milliman.com.

TABLE OF CONTENTS

INTRODUCTION 4

VARIABLE ANNUITIES AND GUARANTEED BENEFITS – BACKGROUND 5

GUARANTEED MINIMUM DEATH BENEFITS (GMDBS) 5

GUARANTEED MINIMUM INCOME BENEFITS (GMIBS) 5

GUARANTEED MINIMUM ACCUMULATION BENEFITS (GMABS) 5

GUARANTEED MINIMUM WITHDRAWAL BENEFITS (GMWBS) 5

CURRENT STATUTORY RESERVING GUIDELINES 7

ACTUARIAL GUIDELINE 33 7

ACTUARIAL GUIDELINE 34 7

ACTUARIAL GUIDELINE 39 7

PROBLEMS WITH EXISTING STATUTORY RESERVING APPROACHES 8

A SHORT HISTORY OF AG VACARVM/AG 43 9

CURRENT PROVISIONS FOR AG 43 (A HIGH LEVEL SUMMARY) 10

SCOPE 10

EFFECTIVE DATE 10

COMPONENTS OF THE CALCULATION 10

CONDITIONAL TAIL EXPECTATION (CTE) AMOUNT 11

STANDARD SCENARIO FLOOR 11

DIFFERENCES BETWEEN AG 43 AND C-3 PHASE II (A HIGH LEVEL SUMMARY) 13

GENERAL DIFFERENCES 13

DIFFERENCES FOR THE STOCHASTIC COMPONENT OF THE CALCULATION 13

DIFFERENCES FOR THE STANDARD SCENARIO COMPONENT OF THE CALCULATION 14

CASE STUDIES 15

GMDB/GMIB PRODUCT DESIGNS 15

GMDB/GMIB Model Assumptions 15

Results and Analysis 17

GLWB PRODUCT DESIGN 26

GLWB Model Assumptions 26

Results and Analysis 27

REASONS WHY THE STANDARD SCENARIO MAY EXCEED THE STOCHASTIC REQUIREMENT 32

IMPACT OF AG 43 AND C-3 PHASE II ON FUTURE PRODUCT DESIGNS 33

APPENDIX 1 - CURRENT PROVISIONS FOR AG 43 (A DETAILED SUMMARY) 37

GUIDING PRINCIPLES FOR THE CTE AMOUNT CALCULATION (PARAPHRASED) 37

CTE AMOUNT - ASSUMPTIONS AND METHODOLOGY 37

Assumptions 37

Discount rates 38

Scenarios 39

Hedging 39

STANDARD SCENARIO FLOOR 41

Assumptions 41

Discount rates 44

Hedging 44

OTHER REQUIREMENTS 45

Model Granularity 45

Reinsurance 45

APPENDIX 2 - DIFFERENCES BETWEEN AG 43 AND C-3 PHASE II (A DETAILED SUMMARY) 46

APPLICABILITY 46

DIFFERENCES WITH RESPECT TO THE STOCHASTIC CALCULATION 46

Treatment of Federal Income Taxes (FIT) 46

CTE Metric 46

Revenue Sharing 46

Assumptions 47

Discount Rates 47

Hedging 48

STANDARD SCENARIO 48

Discount rate definition 48

Drop and Recovery 48

Revenue Margin 49

Mortality 49

Lapses/ITM 49

Election Rates 50

APPENDIX 3 – CASE STUDY GENERAL ASSUMPTIONS 51

Discounting 51

Taxes 51

Economic Scenarios 51

Hedging 51

Model Horizon 51

INTRODUCTION

Variable annuities (VAs) and the guaranteed benefits that are embedded in such products have been available in the U.S. marketplace for a number of years. During this time, there have been several regulatory approaches under which insurance companies have calculated statutory reserves and risk-based capital for these products. These approaches have largely been viewed by the insurance industry as temporary solutions, exhibiting a formulaic or rules-based paradigm. The effectiveness of such approaches has been reduced as a consequence of continued product innovation and competitive market pressures, both of which have driven the growth of VAs with increasingly complex guaranteed benefits. As a direct result, the need has arisen for reserving and capital approaches that more appropriately measure the risks embedded in these more complex products.

The introduction of the C-3 Phase II regulatory standard in 2005 for quantifying the market risk embedded in VAs represented a shift from the old paradigm, in favor of a principles-based (and stochastic) approach for determining minimum capital requirements.

The introduction of the C-3 Phase II regulatory standard[1] in 2005 for quantifying the market risk embedded in VAs represented a shift from the old paradigm, in favor of a principles-based (and stochastic) approach for determining minimum capital requirements. The analogous principles-based reserving standard, commonly referred to as AG VACARVM (or the Actuarial Guideline covering the Commissioners' Annuity Reserving Valuation Method for VAs), took somewhat longer to finalize, but was finally adopted in September 2008 by the National Association of Insurance Commissioners (NAIC), with an effective implementation date of Dec. 31, 2009. In light of this adoption, AG VACARVM officially became known as Actuarial Guideline 43 (AG 43). We will use the latter terminology in this paper.

Both the C-3 Phase II and AG 43 approaches are similar—there is a stochastic requirement and a deterministic floor (or Standard Scenario) in both approaches. But subtle differences do exist. Accordingly, this paper will outline the following:

- the evolution of AG 43
- a summary of the current provisions of AG 43
- the contrast between the provisions of AG 43 and C-3 Phase II
- a case study showing typical reserving and capital requirements for certain product designs under both C-3 Phase II and AG 43
- commentary on the issues relating to the Standard Scenario, and how the latter may compare to the stochastic requirement under particular product designs
- a discussion of the potential impact of AG 43 on future product designs, and various strategies that insurance companies might employ that could help lower reserving and capital requirements

1 This standard is also referred to as the regulation that governs the quantification of the C-3 market risk and interest rate risk components of risk-based capital. In this paper however, we will refer to this as "C-3 Phase II," which is conventional practice in the actuarial industry.

VARIABLE ANNUITIES AND GUARANTEED BENEFITS – BACKGROUND

This introductory section serves to refresh the reader on the form of VAs and to discuss the more common guaranteed benefits. Practitioners already familiar with VA guarantees may choose to skip ahead.

The basic VA contract combines an investment vehicle and an insurance product. The policyholder has the ability to participate in the equity market but also benefits from tax-deferred growth until such time as funds are withdrawn. The premium that the policyholder contributes to fund the contract is invested across *subaccounts* and the evolution of the contract account value over time is in turn governed by the performance of each subaccount. Most VAs also have a fixed (or general) account option that credits interest at a guaranteed rate.

The basic VA contract combines an investment vehicle and an insurance product. The policyholder has the ability to participate in the equity market but also benefits from tax-deferred growth until such time as funds are withdrawn.

Layered onto this base contract are guaranteed benefits, the more common of which are described below.

Guaranteed minimum death benefits (GMDBs)

The original VAs usually offered a return of premium guarantee (less any withdrawals) on death of the policyholder. More typical forms that are popular now are guarantees that utilize Rollup and Ratchet features. The basic Rollup feature accumulates initial premiums (less any withdrawals) using an assumed Rollup percentage rate, typically 3% to 7%. The basic Ratchet is a maximum anniversary calculation that compares the current guarantee to the prevailing account value at an anniversary and resets the guarantee to the larger of the two values. Both these features, typically with subtle variations, are often sold in combination, with the policyholder entitled to a guaranteed value equal to the larger of the two.

Guaranteed minimum income benefits (GMIBs)

The GMIB allows for a minimum amount of income in the form of an annuity (which may take a variety of forms). The guaranteed value is converted to a payout annuity utilizing guaranteed purchase rates (which are based on conservative interest and/or mortality assumptions), provided the policyholder has been in force for a certain minimum number of years. The latter is commonly referred to as a waiting period. The base guaranteed value prior to annuitization usually utilizes Rollup and/or Ratchet features.

Note that the GMIB is an elective benefit, in that the conversion of the policyholder's guaranteed value to an annuity is at his or her own discretion, and is not obligatory.

Guaranteed minimum accumulation benefits (GMABs)

The GMAB provides the policyholder with a minimum guaranteed return after some initial waiting period, with renewal options potentially available. In its simplest form, the guarantee could take the form of a 100% return of premium guarantee after 10 years (net of any withdrawals). Slightly more complicated forms would allow for a return of premium (net of withdrawals) plus a bonus or possibly the option for the policyholder to renew the guarantee for a future term upon expiration of the initial term.

Guaranteed minimum withdrawal benefits (GMWBs)

The GMWB is a relatively more recent guarantee that ensures the policyholder can make systematic annual withdrawals from his or her *benefit base* over a period of time and may continue to do so even though the account value might have depleted. A popular variation on this is the guaranteed lifetime withdrawal benefit (GLWB), which allows for a guaranteed source of income that will last the life of the policyholder. As with other VA guarantees, the benefit base design usually exhibits some form of Rollup and/or Ratchet features in its structure.

Note that GMIBs, GMABs, and GMWBs are often collectively referred to as VAGLBs (VAs with guaranteed living benefits) because, unlike GMDBs, they require the policyholder to survive at least until such time as the benefit may be collected.

These guarantees can be thought of as embedded put options, and typically increase in value (to the policyholder) as equity markets decline. Note that as an embedded put option, both GMIBs and GMWBs in particular are also sensitive to interest rate movements, and increase in value (to the policyholder) as rates fall.

CURRENT STATUTORY RESERVING GUIDELINES

The existing statutory approaches relevant to VAs under the Standard Valuation Law (SVL) are Actuarial Guidelines 33, 34, and 39, which are described briefly below. All are formulaic or rules-based approaches. However, Actuarial Guidelines 34 and 39 are supplemented by standalone asset adequacy analysis (using deterministic or stochastic scenarios, at the judgment of the actuary), which is required to be used to test whether additional reserves need to be set aside to cover the VA guaranteed benefits.

Actuarial Guidelines 34 and 39 are supplemented by standalone asset adequacy analysis which is required to be used to test whether additional reserves need to be set aside to cover the VA guaranteed benefits.

Note that both Actuarial Guidelines 34 and 39 sunset on Dec. 31, 2009, at which point AG 43 becomes effective.

Actuarial Guideline 33

AG 33 is the statutory reserving requirement for a base variable annuity contract. It follows the CARVM methodology, and thus deterministically projects the account value forward using a projection rate equal to the appropriate regulatory specified valuation interest rate less any applicable contract charges. The greatest present value of the resulting guaranteed benefits is then held as the CARVM reserve.

To the extent that there are no guarantees embedded in the contract, or where the death benefit is simply the release of account value on death, the application of AG 33 would be appropriate. However, if the contract has an embedded death benefit with a more sophisticated form—such as would be the case if it exhibited a return of premium, Rollup and/or Ratchet structure—then AG 34 should be used.

Actuarial Guideline 34

AG 34 expands on AG 33, and is the statutory reserving requirement for GMDBs that may be layered onto the base contract. This guideline stipulates using a deterministic approach whereby an immediate drop to the account value is assumed, followed by a recovery to the account value using an assumed return. These drop and recovery assumptions vary by the asset classes: equity, bond, balanced, money market, and specialty. Under these assumptions, the net amount at risk is calculated from the valuation date forward, and the reserve is the present value of any excess GMDB claims (guaranteed death benefit claim amounts in excess of the account value) that have been generated.

Actuarial Guideline 39

AG 39 is the statutory reserving requirement for VAGLBs (VAs with guaranteed living benefits) such as GMIBs, GMWBs, and GMABs. It is essentially a retrospective approach of historical accumulated charges, from the issue date of the contract to the valuation date. From a direct writer's perspective, these charges are simply the rider charges associated with the VAGLB—or, if these charges are part of the contract mortality and expense charge, the *imputed* charge that is attributable to the VAGLB. Note that the accumulation need not consider any (non zero) interest rate assumption.

The AG 39 reserve builds as the contract ages, until such time as termination or annuitization takes place, whereupon the reserve that has built up is released. If annuitization (such as under GMIBs) should occur, the release of the AG 39 reserve into statutory income coincides with the corresponding setup of a payout reserve for the annuity payments.

For a newly issued contract, there is no AG 39 reserve because there are no historical charges that exist yet (assuming the first charge is not up front).

Problems with existing statutory reserving approaches

In certain situations, reserves for these benefits calculated under the existing approaches may be too conservative, and at other times may be too volatile or even potentially unintuitive.

Some industry practitioners believe that the existing approaches, while working well in prior years when guarantees had relatively simple designs, are not always suitable for the risk profile of the more complex guaranteed benefits that are now in the marketplace. In certain situations, reserves for these benefits calculated under the existing approaches may be too conservative, and at other times may be too volatile or even potentially unintuitive. As an example, AG 34 can sometimes result in the same reserve at issue for a contract that has a return of premium GMDB and another contract that has a GMDB Ratchet – a situation that appears counterintuitive given the fact that one would expect a Ratchet feature to cost more to reserve because–from the policyholder's perspective–it is a more valuable benefit. For these reasons, among others, AG 34 and 39 have tended to have been viewed by industry as temporary statutory reserving solutions.

To some extent the above problems may be mitigated by standalone asset adequacy analysis. The Conditional Tail Expectation (CTE) approach under AG 43 (and C-3 Phase II) builds on this by averaging the results corresponding to the worst 30% (10% for C-3 Phase II) of scenarios to obtain the result for the stochastic component of the calculation. The CTE metric is a statistical risk measure that provides valuable information about the tail of a distribution. This metric is intrinsically better at capturing the tail risk associated with variable annuity guaranteed benefits as compared with the existing deterministic AG 34 and 39 methodologies.

A SHORT HISTORY OF AG VACARVM/AG 43

The Life and Health Actuarial Task Force (LHATF), which was commissioned by the NAIC to start the process toward implementing a new principles-based methodology, initiated industry meetings focusing on risk-based capital (RBC) and AG VACARVM in 2004. This led to the introduction of C-3 Phase II in late 2005, with an effective date as of the end of that year.

The document released in June 2005 by the American Academy of Actuaries' Life Capital Adequacy Subcommittee entitled the *Recommended Approach for Setting Risk-based Capital Requirements for Variable Annuities and Similar Products* provided detailed instructions to the practitioner for carrying out C-3 Phase II calculations.

Moreover, at the end of each year since, the NAIC produces (potentially) updated annual statement instructions for the interest-rate and market-rate risk components of RBC that are meant to supplement (or, where applicable, supersede) the June 2005 document.

In contrast, the introduction of AG 43/AG VACARVM (the reserving counterpart to RBC) was, at least until recently, a long time coming. A number of AG VACARVM exposure drafts had been created over the past few years, but a final version agreeable to all parties remained elusive, even as late as mid-2007. The reasons for this essentially related to ongoing disagreement among industry groups and the state regulatory community with regard to several key assumptions that formed parts of the calculation. These included, for example:

- the treatment of Net Revenue-Sharing Income (contractually guaranteed versus noncontractually guaranteed components)
- the appropriate CTE level
- the discount rate for the Standard Scenario
- policyholder behavior assumptions

Despite this, substantial progress was made in resolving these disagreements, and as a result, AG VACARVM was officially adopted by the Life Insurance and Annuities (A) Committee of the NAIC in September 2008, and consequently became known as AG 43.

AG VACARVM was officially adopted by the Life Insurance and Annuities (A) Committee of the NAIC in September 2008, and consequently became known as AG 43.

The (at the time) VACARVM exposure draft that was made available by LHATF on Aug. 20, 2008, forms the basis for much of the information that is provided in this paper. This document is referred to as the AG 43 document in subsequent sections.

CURRENT PROVISIONS FOR AG 43 (A HIGH-LEVEL SUMMARY)

This section will outline the major provisions of AG 43, with comments as appropriate. Note that this is not intended to be an exhaustive summary, but rather to give the reader a high-level overview; subtle points of the calculation are not provided.

The reader is encouraged to read Appendix 1 for more discussion of the underlying assumptions, but perhaps more important, to study the AG 43 document itself in order to gain familiarity with the detailed calculations.

The Alternative Methodology is not discussed.

Scope

Generally speaking, AG 43 applies to all individual, group, deferred, and immediate VAs, irrespective of whether these contracts are written on a direct or an assumed (via reinsurance) basis. In particular, contracts with GMDBs and/or VAGLBs are in scope, although contracts that do not have these guarantees also fall under AG 43. It is expected that any future guarantee variations will also be covered by AG 43.

Products such as fixed indexed annuities, equity index annuities, and variable universal life are covered under other specific reserving requirements, and are not considered to be in scope from the perspective of AG 43.

Effective date

The implementation date for AG 43 is Dec. 31, 2009. However, in those cases where the application of AG 43 produces higher reserves than was the case under the previously used statutory requirements, insurance companies may request a grade-in period of at most three years from the chief insurance regulatory official of the state of domicile of the company. This grade-in period is contingent upon satisfactory demonstration of the previous statutory requirement and that the delay in implementing AG 43 will not have an adverse impact on the insurance company or its policyholders.

Components of the calculation

The significant components of the AG 43 calculation are the Conditional Tail Expectation Amount and the Standard Scenario Amount.

The significant components of the AG 43 calculation are the Conditional Tail Expectation Amount (CTE Amount) and the Standard Scenario Amount. The former utilizes a CTE 70 metric and is stochastic in nature, whereas the latter is a deterministic floor that is comparable to the existing AG 34 reserving methodology in that it relies on a single drop and recovery scenario.

The salient features of both the CTE Amount and Standard Scenario Amount calculation are briefly summarized below. A more detailed discussion of the underlying assumptions is presented in Appendix 1.

The AG 43 reserve, referred to as the Aggregate Reserve, is formally defined as the Standard Scenario Amount plus the excess, if any, of the CTE Amount over the Standard Scenario Amount.

Conditional Tail Expectation Amount

The CTE Amount calculation makes use of stochastic projections across many economic scenarios so as to be able to capture the tail risk that exists for the in-force block that is being modeled. In particular, the calculation utilizes a method called the Greatest Present Value of Accumulated Deficiencies (GPVAD) to measure solvency, where cash flows are projected under prudent estimate assumptions and using scenarios that meet specific calibration requirements. The assumptions that are used must be documented and also supported by credible experience analysis.

For a given scenario under the GPVAD method, Accumulated Deficiencies are calculated, equal to the projected Working Reserve less the amount of projected assets that are calculated from the valuation date forward. The Working Reserve at any point in time during the projection is defined to be the projected cash surrender value. It is important to note that the projection should ignore taxes and should also reflect all the features of the contract, including guaranteed benefits.

For a given scenario under the GPVAD method, Accumulated Deficiencies are calculated, equal to the projected Working Reserve less the amount of projected assets that are calculated from the valuation date forward.

Depending on the scenario under consideration, the Accumulated Deficiency at the end of a given projection year may be positive or negative, implying either a cumulative loss or gain to the company, respectively (at that time, and for that scenario).

For a particular scenario, the Accumulated Deficiencies at the end of each and every projection year are discounted back to the valuation date, and the greatest of them (that is to say, the largest positive deficiency) is added to the Starting Asset Amount, which is the amount of statutory reserves at the start of the projection. The discount rates that are utilized are the interest rates at which positive cash flows are invested, on a pre-tax basis.

This generates the GPVAD for that scenario. Thus, each and every scenario has a single GPVAD. The reasoning behind discounting each and every projection year's Accumulated Deficiency is to try and determine the minimum level of capital that would be adequate to preserve company solvency throughout the projection.

This process is then repeated for all scenarios, and the CTE 70 metric is ultimately calculated based on the arithmetic average of 30% of the largest GPVAD, assuming that each of the latter values are non-negative (any negative values, which imply cumulative gains to the company under the scenario in question, are treated as zero values in the average–thus *only* losses contribute to the CTE metric).

Considerations for the treatment of hedging and reinsurance are discussed in Appendix 1.

Standard Scenario floor

The Standard Scenario Amount is calculated as the sum of the Standard Scenario Reserve for each contract. The calculation is seriatim in nature, and utilizes a single drop/recovery scenario applied to the separate account asset classes, and is thus conceptually similar to that prescribed under AG 34.

The drop that is applied is an instantaneous reduction to the account value, followed by a subsequent recovery using specified returns (less contract and fund charges). In contrast to the method outlined for the CTE Amount, where the actuary has the ability to set prudent estimate assumptions (which must be supportable by experience analysis), the assumptions that are used in the Standard Scenario Reserve calculation are specified.

As with the calculation of the CTE Amount, the Standard Scenario Amount calculation is performed entirely on a pre-tax basis, with respect to both the discounting and the projected cash flows.

The Standard Scenario Reserve is calculated using the Greatest Present Value of the Accumulated Net Revenues at the end of each and every projection year, plus the Basic Adjusted Reserve.

Conceptually, the Accumulated Net Revenues utilize the guaranteed benefits that are paid out less the revenues generated from the prescribed Standard Scenario margins, allowing for any individual reinsurance. There is also a provision for the allocation of any static hedges and aggregate reinsurance. More detail on this is provided in Appendix 1.

The Basic Adjusted Reserve is the reserve obtained by applying statutory valuation requirements applicable immediately prior to the adoption of AG 43 (referred to as the Basic Reserve), with the additional requirement that free partial withdrawal provisions are ignored when determining surrender charges.

Last, a floor amount equal to the cash surrender value is also applied, so that for a particular contract, the calculated Standard Scenario Reserve may not be less than the cash surrender value for that contract.

The definition of the Standard Scenario Amount implies that aggregation of the cash in-flows and cash out-flows used to calculate the Greatest Present Values across contracts is not permitted. Instead, a Standard Scenario Reserve is calculated for each standalone contract using the Greatest Present Value methodology, and the Standard Scenario Amount is then the sum of the Standard Scenario Reserve for all contracts.

It is important to note that the definition of the Standard Scenario Amount implies that aggregation of the cash in-flows and cash out-flows used to calculate the Greatest Present Values across contracts is not permitted. Instead, a Standard Scenario Reserve is calculated for each standalone contract using the Greatest Present Value methodology described above, and the Standard Scenario Amount is then the sum of the Standard Scenario Reserve for all contracts.

DIFFERENCES BETWEEN AG 43 AND C-3 PHASE II (A HIGH-LEVEL SUMMARY)

From the practitioner's perspective, it is worth noting that the intent of AG 43 is to establish a framework whereby companies may determine reserving and capital requirements using the same model. The similar nature of the methodologies between reserving and capital requirements makes this feasible–that is to say, it is expected that (largely) the same model formulas and assumptions will be used to produce results for both purposes. This is appealing from both a consistency and ease of modeling perspective.

The intent of AG 43 is to establish a framework whereby companies may determine reserving and capital requirements using the same model. The similar nature of the methodologies between reserving and capital requirements makes this feasible.

That being said, this section outlines the major differences between AG 43 and C-3 Phase II in tabular form. As before, this is not intended to be an exhaustive summary of such differences. Although we refer the reader to Appendix 2 for a more detailed discussion of the differences between both approaches, readers are also encouraged to study the AG 43 and the C-3 Phase II June 2005 documentation (along with subsequent year end NAIC annual statement instructions) in order to better familiarize themselves with differences that may exist.

GENERAL DIFFERENCES		
	AG 43	C-3 PHASE II
APPLICABILITY	ALL IN-SCOPE CONTRACTS ISSUED ON OR AFTER JAN. 1, 1981	ALL IN-SCOPE CONTRACTS REGARDLESS OF ISSUE DATE
TAX TREATMENT FOR CASH FLOWS AND DISCOUNTING	PRE-TAX BASIS	AFTER-TAX BASIS

DIFFERENCES FOR THE STOCHASTIC COMPONENT OF THE CALCULATION		
STOCHASTIC	AG 43	C-3 PHASE II
TERMINOLOGY	CONDITIONAL TAIL EXPECTATION (CTE) AMOUNT	TOTAL ASSET REQUIREMENT (TAR)
CTE METRIC	CTE 70 (AVERAGE OF THE WORST 30% OF GPVADS)	CTE 90 (AVERAGE OF THE WORST 10% OF GPVADS)
NET REVENUE-SHARING INCOME	RESTRICTION ON THE AMOUNT OF NONCONTRACTUALLY GUARANTEED NET REVENUE-SHARING INCOME THAT CAN BE RECOGNIZED	ALL NET REVENUE-SHARING INCOME IS RECOGNIZED
DISCOUNT RATE	INTEREST RATES AT WHICH POSITIVE CASH FLOWS ARE INVESTED (ON A PRE-TAX BASIS)	1-YEAR TREASURY RATE FROM AN INTEGRATED MODEL OR FORWARD INTEREST RATES IMPLIED BY THE VALUATION DATE SWAP CURVE (ON AN AFTER-TAX BASIS)
HEDGING	MAXIMUM EFFECTIVENESS FACTOR OF 70%	MAXIMUM EFFECTIVENESS FACTOR OF 95%

DIFFERENCES FOR THE STANDARD SCENARIO COMPONENT OF THE CALCULATION		
	AG 43	C-3 PHASE II
DISCOUNT RATE	THE (PRE-TAX) SVL INTEREST RATE FOR ANNUITIES VALUED ON AN ISSUE YEAR BASIS, USING PLAN TYPE A WITH GUARANTEED DURATION > 10 YEARS BUT ≤ 20 YEARS	ANNUAL EFFECTIVE EQUIVALENT OF THE (AFTER-TAX) 10-YEAR CMT RATE AS OF THE VALUATION MONTH, PLUS 50 BPS, SUBJECT TO A FLOOR OF 3% AND A CAP OF 9%
DROP AND RECOVERY ASSUMPTIONS	MORE CONSERVATIVE ASSUMPTIONS FOR C-3 PHASE II, CONSISTENT WITH THE NECESSARILY HIGHER LEVEL OF CONSERVATISM IMPLICIT IN DETERMINING CAPITAL REQUIREMENTS (SEE APPENDIX 2 FOR FURTHER DETAILS)	
AGGREGATION	NOT PERMITTED; THE GPVAD AND HENCE THE SSR MUST BE DETERMINED FOR EACH CONTRACT ON A STANDALONE BASIS, AND THEN SUMMED TO GET THE SSA	ALLOWED; ACCUMULATED NET REVENUE IS SUMMED ACROSS ALL CONTRACTS BEFORE DETERMINING THE GPVAD (IN AGGREGATE)
REVENUE MARGINS USED TO CALCULATE NET REVENUES	GENERALLY HIGHER REVENUE MARGINS UNDER AG 43. FOR EXAMPLE, CONTRACTUALLY GUARANTEED NET REVENUE-SHARING INCOME (ONLY) IS INCLUDED UNDER AG 43, WHEREAS NO SUCH RECOGNITION EXISTS UNDER C-3 PHASE II (SEE APPENDIX 2 FOR FURTHER DETAILS)	
MORTALITY	HIGHER MORTALITY UNDER C-3 PHASE II, CONSISTENT WITH THE NECESSARILY HIGHER LEVEL OF CONSERVATISM IMPLICIT IN DETERMINING CAPITAL REQUIREMENTS (SEE APPENDIX 2 FOR FURTHER DETAILS)	
LAPSES/IN-THE-MONEYNESS (ITM)	GENERALLY MORE DEVELOPED UNDER AG 43 AND MORE CONSISTENT WITH EMERGING PRACTICES (SEE APPENDIX 2 FOR FURTHER DETAILS)	
GMIB ELECTION RATES	TIERED BY ITM	15%

CASE STUDIES

This section will present case studies for various GMDB, GMIB, and GMWB designs that have been modeled using Milliman's MG-ALFA® software platform. The goal behind these case studies is to illustrate representative AG 43 and C-3 Phase II stochastic and Standard Scenario requirements using a sample product indicative of what might be found in the current market, and to provide commentary as to the patterns in the results.

Note that:

- A single policy for a male age 65 has been modeled *from issue* assuming a 100% equity investment in the S&P 500 Index.
- The numerical results shown are the required reserves or capital amounts in excess of the cash surrender value, as of the issue date, expressed as a percentage of the initial account value.

For the stochastic calculation, it is important to note that in practice an entire in-force file will be used to project cash flows. The results for all the cells in the in-force file would be aggregated within each scenario and a single GPVAD calculated for all the cells for that scenario. Consequently, there will be some natural offsetting of risk whereby favorable Accumulated Deficiencies for some cells will make up for unfavorable Accumulated Deficiencies on others.

For the stochastic calculation, it is important to note that in practice an entire in-force file will be used to project cash flows. The results for all the cells in the in-force file would be aggregated within each scenario and a single GPVAD calculated for all the cells for that scenario.

GMDB/GMIB product designs

The base product designs that have been modeled include

GMDB designs
1. Annual Ratchet only
2. 5% Rollup only
3. greater of (1) and (2)

GMIB designs
4. Annual Ratchet only
5. 5% Rollup only
6. greater of (4) and (5)

A combination GMDB/GMIB product representing (3) and (6) has also been modeled.

GMDB/GMIB model assumptions

Base cell: Male, issue age 65

Single premium: $100,000

Allocation: 100% to the S&P 500 Index

M&E assumption: 150 bps, applied to the entire account value

Investment management fee: 100 bps with a 25 bps re-allowance for all funds

Commission: 7% of initial premium, with no trail or charge-backs

Acquisition expenses: 150 bps of premium and $125 per policy

Maintenance expenses: $80 per policy, growing at 3% each year

GMDB assumptions:

- GMDB coverage to attained age 85
- Ratchet: Maximum anniversary value, to attained age 80 only
- Rollup: An annual 5% compounded interest rate, to attained age 80 only
- Ratchet/Rollup: Greater of the Ratchet and the Rollup

GMIB assumptions

- GMIB coverage to attained age 85
- A waiting period of seven years (post-issue) before GMIB annuitization is permitted
- Ratchet: Maximum anniversary value, to attained age 80 only
- Rollup: An annual 5% compounded interest rate, to attained age 80 only
- Ratchet/Rollup: Greater of the Ratchet and the Rollup

GMDB AND GMIB RIDER CHARGES:

RIDER	CHARGE
GMDB RATCHET	15 BPS
GMDB ROLLUP	15 BPS
GMDB RATCHET/ROLLUP	20 BPS
GMIB RATCHET	25 BPS
GMIB ROLLUP	25 BPS
GMIB RATCHET/ROLLUP	40 BPS
GMDB/GMIB RATCHET/ROLLUP	60 BPS

The rider charges are applied to the account value.

Surrender charge schedule: 8%, 7%, 6%, 5%, 4%, 3%, 2%, 0% (% of account value)

Mortality: 65% of the MGDB 1994 Age Last Birthday mortality table

Base Lapses: 1.5%, 4%, 4%, 4%, 6%, 8%, 10%, 30%, 20%, and 10% thereafter

Base GMIB dynamic lapse formula:

Factor = Min (100%, max (10%, 1 – 75% × [GMIB ITM – 110%])) where GMIB ITM = Present value of GMIB payments / account value

No dynamic lapse assumption for the GMDB is assumed.

Sensitivity GMIB dynamic lapse formula:

Factor = Min (100%, max (10%, $[\text{GMIB ITM}]^{-0.2\times t}$)) where t refers to policy years and GMIB ITM = Present value of GMIB payments / account value

No dynamic lapse assumption for the GMDB is assumed.

GMIB elections:

Election rate = Min (50%, GMIB ITM)

Elections are only possible at policy-year anniversaries.

Partial withdrawals: An annual 2% of account value, applied on a monthly basis. In addition, there is a 10% free withdrawal assumption. Partial withdrawals are deducted from the guarantee on a pro-rata basis.

Current/market annuitization assumptions: Life and 10-year annuity factors, calculated using 65% of the MGDB 1994 Age Last Birthday mortality table and 20-year Treasury interest rates (obtained from the assumed real world scenarios).

GMIB purchase rates: Calculated purchase rates assuming life and 10-year payments, using 100% of the 2000 Annuity Table with Projection Scale G improvement and a guaranteed interest rate of 3%.

Results and analysis

Under current statutory reserving methods, the GMDB rider is valued under AG 34 and the GMIB rider under AG 39.

Under current statutory reserving methods, the GMDB rider is valued under AG 34 and the GMIB rider under AG 39. As discussed earlier, the statutory reserve for the GMIB at issue equals zero because we are modeling new business and AG 39 is a retrospective accumulation of past charges (and there are none in this case).

For the base contract itself, the base statutory reserve is valued using AG 33. Although we have not explicitly calculated the requirement, the extra requirement (if any) is usually an amount such that the cash surrender value plus the base requirement lies in between the cash surrender value and the fund value. In particular, unless there are very favorable long term interest guarantees, the Greatest Present Value calculated under AG 33 usually occurs during the surrender charge period.

For the GMDB Annual Ratchet, 5% Rollup, and combination designs, the reserving requirement under AG 34 is quite modest: approximately 0.06%, 0.22% and 0.22% of initial AV, respectively.

The base AG 43 and C-3 Phase II results are presented in Table 1 below. As stated earlier, the results shown represent the required reserves or capital amounts in excess of the cash surrender value, as of the issue date, expressed as a percentage of the initial account value. Note that a red font entry serves notice that the Standard Scenario result exceeds the stochastic result for that product design.

TABLE 1: BASE

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	1.9%	2.3%	0.0%	0.7%
DB ROLLUP	3.3%	4.4%	2.5%	7.3%
DB RATCHET/ROLLUP	3.2%	4.2%	2.5%	7.4%
IB RATCHET	2.4%	3.6%	0.0%	0.0%
IB ROLLUP	6.0%	9.7%	5.4%	11.5%
IB RATCHET/ROLLUP	5.9%	9.6%	5.2%	11.3%
DB/IB RATCHET/ROLLUP	7.9%	12.0%	10.1%	18.9%

Some comments on these base results are worth noting:

- The reserving requirement (under AG 43) is less than the capital requirement (under C-3 Phase II) for the stochastic calculation. This is typically the case (for at-issue valuations), because the TAR calculation under C-3 Phase II utilizes a CTE 90 metric rather than a CTE 70, which is required under AG 43.

- As might be expected, the reserving requirement (under AG 43) is less than the capital requirement (under C-3 Phase II) for the Standard Scenario calculation. This is attributable to the fact that under C-3 Phase II, the immediate drops for certain asset classes are greater (more of an unfavorable shock), and the recovery returns for these classes are also lower. Both of these observations make sense given the higher level of conservatism implicit in determining capital requirements (as opposed to reserves). To a lesser extent, other assumption differences between both formulations of the Standard Scenario contribute to the variance. For example, under the AG 43 Standard Scenario, contractually guaranteed Net Revenue-Rharing Income may be reflected in the revenue margins; under the C-3 Phase II Standard Scenario, however, Net Revenue-Sharing Income in any form is not recognized as an income component. Depending on how much may be reflected (the base case study results assumes 100%), this may result in slightly lower reserving requirements than might otherwise be the case.

The requirements for the GMIB product designs are higher (more unfavorable) than the GMDB product designs. The former tends to be more of an expensive benefit to the writing company as is evidenced by the higher rider charges that typically apply to GMIBs.

- The requirements for the GMIB product designs are higher (more unfavorable) than the GMDB product designs. The former tends to be more of an expensive benefit to the writing company as is evidenced by the higher rider charges that typically apply to GMIBs. However, this also depends on the age of the individual being modeled–higher ages would tend to result in higher requirements for GMDBs than GMIBs, for example.

- Rollup designs tend to result in higher requirements than the annual Ratchet designs. This can be attributed to the fact that the projected equity returns less all applicable fees and charges that is used to grow the account value tends to be less than the annual 5% Rollup assumption that is used to increase the guarantee base. Thus, even under a moderately favorable upward equity scenario, the Rollup design may be a more valuable benefit to the policyholder while the Ratchet design simply steps up to the current account value (if higher than the prevailing guarantee) without any resulting net amount at risk.

- The combination of the Rollup and Ratchet designs tends to have a lower requirement than a standalone Rollup design because the marginal effect on projected revenue as a result of incorporating the additional rider charge for the Ratchet more than offsets the corresponding marginal increase in projected benefits that are paid out.

In order to gauge the variation in the stochastic and Standard Scenario results, sensitivities to the base case were performed. The results for these sensitivities, along with the accompanying discussion are presented below (see Tables 2-8).

TABLE 2: 3% ROLLUP / 7% ROLLUP

	3% ROLLUP				7% ROLLUP			
	STOCHASTIC		STANDARD SCENARIO		STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET								
DB ROLLUP	2.4%	3.0%	0.0%	4.3%	5.0%	6.3%	6.8%	11.1%
DB RATCHET/ROLLUP	2.3%	3.0%	0.0%	4.3%	4.8%	6.1%	6.8%	11.1%
IB RATCHET								
IB ROLLUP	3.4%	5.4%	0.0%	5.3%	11.0%	15.3%	14.9%	19.0%
IB RATCHET/ROLLUP	3.4%	5.6%	0.0%	5.2%	10.7%	15.2%	14.7%	18.7%
DB/IB RATCHET/ ROLLUP	4.5%	7.4%	0.0%	10.5%	14.0%	18.3%	21.8%	29.2%

CHANGE COMPARED TO THE BASE RESULTS

	3% ROLLUP				7% ROLLUP			
	STOCHASTIC		STANDARD SCENARIO		STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET								
DB ROLLUP	-0.9%	-1.3%	-2.5%	-3.1%	+1.7%	+1.9%	+4.3%	+3.7%
DB RATCHET/ROLLUP	-0.8%	-1.3%	-2.5%	-3.1%	+1.6%	+1.9%	+4.3%	+3.7%
IB RATCHET								
IB ROLLUP	-2.6%	-4.2%	-5.4%	-6.2%	+5.0%	+5.7%	+9.6%	+7.5%
IB RATCHET/ROLLUP	-2.5%	-4.0%	-5.2%	-6.1%	+4.8%	+5.6%	+9.5%	+7.4%
DB/IB RATCHET/ ROLLUP	-3.4%	-4.6%	-10.1%	-8.4%	+6.2%	+6.3%	+11.7%	+10.3%

The Rollup sensitivities alternatively result in a greater (7%) or lesser requirement (3%), which is as expected because the base Rollup interest rate assumption is 5%. Note that the rider charge was not changed under each sensitivity. In practice, a higher (lower) charge would be applied for a more generous (conservative) Rollup interest rate assumption.

TABLE 3: 100% OF THE UNDERLYING MORTALITY TABLE (RATHER THAN 65%)

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	2.7%	3.2%		
DB ROLLUP	5.3%	6.7%		
DB RATCHET/ROLLUP	5.2%	6.6%		
IB RATCHET	2.4%	3.5%		
IB ROLLUP	5.7%	9.1%		
IB RATCHET/ROLLUP	5.6%	9.0%		
DB/IB RATCHET/ROLLUP	8.9%	12.6%		

CHANGE COMPARED TO THE BASE RESULTS

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	+0.7%	+1.0%		
DB ROLLUP	+2.0%	+2.3%		
DB RATCHET/ROLLUP	+2.0%	+2.3%		
IB RATCHET	-0.0%	-0.2%		
IB ROLLUP	-0.3%	-0.6%		
IB RATCHET/ROLLUP	-0.3%	-0.6%		
DB/IB RATCHET/ROLLUP	+1.0%	+0.7%		

The higher mortality assumption increases the reserve and capital requirements for the GMDB-only designs and correspondingly reduces the requirements for GMIB-only designs.

For the mortality sensitivity, 100% of the underlying MGDB 1994 table was used rather than 65% of the same table. The higher mortality assumption increases the reserve and capital requirements for the GMDB-only designs and correspondingly reduces the requirements for GMIB-only designs. The former is consistent with the fact that under the sensitivity, the mortality rates used to calculate claim amounts are now higher, and therefore the GMDB claims themselves would be higher. On the other hand, a higher mortality assumption implies that the cohort that potentially elects to annuitize their GMIB would be smaller (as compared to the base case), and so GMIB claims and, ultimately, the reserving and capital requirements would be reduced for GMIB only designs.

Note that the Standard Scenario prescribes the mortality assumption that is used in the projection, and so no sensitivity for the Standard Scenario was performed.

TABLE 4: GUARANTEES ARE 10% AND 20% IN THE MONEY AT ISSUE

	GUARANTEES ARE 10% ITM AT ISSUE				GUARANTEES ARE 20% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	2.3%	2.6%	0.0%	2.0%	2.7%	3.2%	0.0%	3.3%
DB ROLLUP	4.4%	5.5%	4.8%	9.3%	5.8%	6.7%	7.2%	11.3%
DB RATCHET/ROLLUP	4.2%	5.4%	4.9%	9.4%	5.6%	6.6%	7.2%	11.4%
IB RATCHET	2.7%	4.1%	0.0%	0.0%	3.2%	5.1%	0.0%	1.8%
IB ROLLUP	8.8%	13.3%	10.4%	14.9%	12.5%	17.3%	15.2%	18.1%
IB RATCHET/ROLLUP	8.6%	13.2%	10.1%	14.6%	12.3%	17.2%	15.0%	17.9%
DB/IB RATCHET/ ROLLUP	11.8%	16.3%	16.9%	24.1%	16.8%	21.2%	23.5%	29.1%

CHANGE COMPARED TO THE BASE RESULTS

	GUARANTEES ARE 10% ITM AT ISSUE				GUARANTEES ARE 20% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	+0.3%	+0.4%	-0.0%	+1.3%	+0.8%	+0.9%	-0.0%	+2.6%
DB ROLLUP	+1.1%	+1.2%	+2.4%	+2.0%	+2.5%	+2.3%	+4.7%	+4.0%
DB RATCHET/ROLLUP	+1.1%	+1.1%	+2.4%	+2.0%	+2.4%	+2.3%	+4.7%	+4.0%
IB RATCHET	+0.3%	+0.5%	-0.0%	+0.0%	+0.8%	+1.5%	-0.0%	+1.8%
IB ROLLUP	+2.8%	+3.6%	+5.0%	+3.4%	+6.5%	+7.6%	+9.9%	+6.6%
IB RATCHET/ROLLUP	+2.7%	+3.6%	+5.0%	+3.4%	+6.4%	+7.6%	+9.8%	+6.6%
DB/IB RATCHET/ ROLLUP	+4.0%	+4.3%	+6.8%	+5.2%	+9.0%	+9.2%	+13.4%	+10.2%

TABLE 5: GUARANTEES ARE 30%, AND 40% IN THE MONEY AT ISSUE

	GUARANTEES ARE 30% ITM AT ISSUE				GUARANTEES ARE 40% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	3.3%	3.8%	0.7%	4.6%	4.0%	4.5%	1.5%	6.0%
DB ROLLUP	7.3%	7.9%	9.6%	13.3%	9.0%	9.1%	11.9%	15.3%
DB RATCHET/ROLLUP	7.1%	7.8%	9.6%	13.4%	8.7%	9.0%	12.0%	15.3%
IB RATCHET	4.0%	6.6%	0.0%	4.1%	5.2%	8.7%	0.0%	6.1%
IB ROLLUP	17.0%	21.6%	20.0%	21.4%	22.1%	26.3%	24.8%	24.6%
IB RATCHET/ROLLUP	16.8%	21.6%	19.7%	21.1%	22.0%	26.3%	24.5%	24.4%
DB/IB RATCHET/ ROLLUP	22.6%	26.5%	30.0%	34.1%	28.9%	32.1%	36.5%	39.1%

CHANGE COMPARED TO THE BASE RESULTS

	GUARANTEES ARE 30% ITM AT ISSUE				GUARANTEES ARE 40% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	+1.4%	+1.5%	+0.7%	+4.0%	+2.1%	+2.2%	+1.5%	+5.3%
DB ROLLUP	+4.0%	+3.6%	+7.1%	+6.0%	+5.7%	+4.8%	+9.5%	+8.0%
DB RATCHET/ROLLUP	+3.9%	+3.5%	+7.1%	+6.0%	+5.6%	+4.8%	+9.5%	+8.0%
IB RATCHET	+1.6%	+3.0%	-0.0%	+4.1%	+2.8%	+5.1%	-0.0%	+6.1%
IB ROLLUP	+11.0%	+11.9%	+14.7%	+9.9%	+16.1%	+16.6%	+19.4%	+13.1%
IB RATCHET/ROLLUP	+10.9%	+12.0%	+14.6%	+9.9%	+16.1%	+16.7%	+19.4%	+13.1%
DB/IB RATCHET/ ROLLUP	+14.7%	+14.5%	+19.9%	+15.2%	+21.1%	+20.1%	+26.3%	+20.1%

The sensitivities that are ITM at issue clearly result in higher requirements under both AG 43 and C-3 Phase II, and in many cases both of the Standard Scenario results dominate their respective stochastic requirements.

As indicated in Tables 4 and 5, the sensitivities that are ITM at issue clearly result in higher requirements under both AG 43 and C-3 Phase II, and in many cases both of the Standard Scenario results dominate their respective stochastic requirements. Under the Standard Scenario, for contracts that are 40% ITM at issue, for example, the reserve and capital requirements are approximately 37% and 39% respectively for the GMDB/GMIB greater of the Annual Ratchet and 5% Rollup design. These general results are particularly worrying for insurance companies that have sold similar VAs that are considerably in the money due to the recent equity market declines.

TABLE 6: ALTERNATIVE GMIB DYNAMIC LAPSE FUNCTION

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET				
DB ROLLUP				
DB RATCHET/ROLLUP				
IB RATCHET	2.4%	3.5%		
IB ROLLUP	6.4%	10.2%		
IB RATCHET/ROLLUP	6.3%	10.1%		
DB/IB RATCHET/ROLLUP	8.4%	12.5%		

CHANGE COMPARED TO THE BASE RESULTS - ALTERNATE DYNAMIC LAPSE ASSUMPTION

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET				
DB ROLLUP				
DB RATCHET/ROLLUP				
IB RATCHET	+0.1%	+0.2%		
IB ROLLUP	+0.4%	+0.5%		
IB RATCHET/ROLLUP	+0.4%	+0.5%		
DB/IB RATCHET/ROLLUP	+0.6%	+0.6%		

The alternative GMIB dynamic lapse function results in slightly higher reserving and capital requirements for both the stochastic calculations (utilization of the dynamic lapse assumption is not permitted under the Standard Scenario), as indicated in Table 6. Note that any dynamic lapse function that is utilized must be justifiable with respect to the emerging actual experience of the company, assuming this is sufficiently credible. If the latter is not the case, then a generic function such as the one that is used for the base analysis may be appropriate in order to introduce some element of conservatism with respect to trying to reflect a reduction in lapses when the guarantees are ITM.

Any dynamic lapse function that is utilized must be justifiable with respect to the emerging actual experience of the company, assuming this is sufficiently credible.

- Only 50% of the Net Revenue-Sharing Income in the AG 43 CTE Amount calculation is contractually guaranteed (and therefore reflected)

TABLE 7: 50% REVENUE-SHARING

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	2.0%		0.0%	
DB ROLLUP	3.4%		3.3%	
DB RATCHET/ROLLUP	3.3%		3.3%	
IB RATCHET	2.5%		0.0%	
IB ROLLUP	6.1%		6.1%	
IB RATCHET/ROLLUP	6.0%		5.8%	
DB/IB RATCHET/ROLLUP	8.0%		10.8%	

CHANGE COMPARED TO THE BASE RESULTS - 50% REVENUE-SHARING

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB RATCHET	+0.1%		-0.0%	
DB ROLLUP	+0.1%		+0.8%	
DB RATCHET/ROLLUP	+0.1%		+0.8%	
IB RATCHET	+0.0%		-0.0%	
IB ROLLUP	+0.1%		+0.7%	
IB RATCHET/ROLLUP	+0.1%		+0.7%	
DB/IB RATCHET/ROLLUP	+0.1%		+0.7%	

The 50% contractually guaranteed net revenue-sharing income sensitivity resulted in slightly higher reserving and capital requirements for the stochastic AG 43 calculation and the AG 43 Standard Scenario calculation.

The 50% contractually guaranteed Net Revenue-Sharing Income sensitivity resulted in slightly higher reserving and capital requirements for the stochastic AG 43 calculation and the AG 43 Standard Scenario calculation.

Note that there is no similar sensitivity that is applicable for the C-3 Phase II calculations, because 100% of the Net Revenue-Sharing Income is always reflected in the TAR calculation (irrespective of whether or not a portion is noncontractually guaranteed), and the C-3 Phase II Standard Scenario calculation does not reflect Net Revenue-Sharing Income at all.

Interestingly, the impact of this to the stochastic calculation in this case study is quite small, which is likely due to fact that the sum of the contractually guaranteed Net Revenue-Sharing Income and non-contractually guaranteed Net Revenue-Sharing Income (subject to a declining haircut and eventual cap) is recognized in the AG 43 stochastic calculation, whereas the AG 43 Standard Scenario reflects only the contractually guaranteed portion in the revenue margins. For the practitioner, the impact of this sensitivity is clearly a function of both the noncontractually guaranteed component and how much Net Revenue-Sharing Income (investment management fees after recognition of related expenses) is assumed in the model. It should be noted that the practitioner will need to justify the contractually guaranteed/noncontractually guaranteed split that may be used in the modeling.

- Reflection of simple hedging for the stochastic calculation using a 70% credit for the claims and assuming an 130 bps cost of the hedging program (just for the GMDB/GMIB greater of the Annual Ratchet and 5% Rollup design)

TABLE 8: HEDGING (70% CREDIT,130 BPS COST)

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB/IB RATCHET/ROLLUP	7.7%	7.7%		
REPORTED	7.8%	10.7%		

CHANGE COMPARED TO THE BASE RESULTS - HEDGING (70% CREDIT,130 BPS COST)

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
DB/IB RATCHET/ROLLUP	-0.2%	-4.3%		
REPORTED	-0.1%	-1.3%		

The reflection of hedging in the model (assuming that the requirements for doing so are met and that the hedging program meets the definition of a clearly defined hedging strategy) results in a lowering of the reserving and capital requirements, although the reduction for the former is somewhat less than the latter. Note that there are two projections that are necessary to report the hedged results. The first is a projection that reflects the hedging, called the CTE Amount (Best Efforts), which is represented in the first row of Table 8. The second is a projection that reflects no hedging, called the CTE Amount (Adjusted), which is represented by the base results in Table 1. The final reported results are given in the second row of Table 8, and are calculated using the credibility-based approach laid out in the AG 43 document and the C-3 Phase II instructions, assuming an effectiveness factor of 30% (or equivalently, 70% for the C-3 Phase II calculation). This calculation is described in more detail in Appendix 1. It is important to note that the above is very much a simple reflection of hedging. In order to model hedge cash flows more accurately, a full-blown nested stochastic calculation where the liability Greeks would be calculated each reporting cycle would be required. Although the latter may justify a higher effectiveness factor, there would be a considerable increase in model run time.

It is interesting that the reduction in the AG 43 stochastic requirement due to hedging is much lower than the corresponding reduction in the C-3 Phase II stochastic requirement. In fact, it may be possible that including hedging in the calculation may actually increase the requirement under AG 43; this depends on the distribution of GPVADs and, in particular, the distribution of values in the conditional average used in the CTE 70 metric calculation. The benefit of hedging may only manifest itself in a smaller subset of the tail, so expanding the tail may result in a higher requirement. The requirement under AG 43 is also likely to be a function of the underlying benefit cost of the guarantees: The higher the cost, the higher the corresponding reserve requirement.

The reduction in the AG 43 stochastic requirement due to hedging is much lower than the corresponding reduction in the C-3 Phase II stochastic requirement. In fact, it may be possible that including hedging in the calculation may actually increase the requirement under AG 43.

Note that dynamic hedging is not reflected in the Standard Scenario and so no calculations were performed for the latter.

The Ratchet design under the Standard Scenario is not affected to any great extent under most of the sensitivities. This is especially the case for GMIB designs or products modeled under AG 43.

As a final point, it is interesting that the Ratchet design under the Standard Scenario is not affected to any great extent under most of the sensitivities. This is especially the case for GMIB designs or products modeled under AG 43. Although this might be attributable to the volatility of the scenarios, we would expect that, generally, the Ratchet benefit would have lower requirements than other designs because the Ratchet typically has a higher frequency of claims but a lower severity (because the benefit amount is stepped up to the account value).

GLWB product design

The GLWB is a lifetime form of the GMWB product that allows policyholders to withdraw a minimum amount throughout their lifetimes regardless of the performance of their underlying subaccounts, and, in particular, even if their account values are fully depleted.

The guaranteed amount that is withdrawn is a percentage of the benefit base, and is locked in at the attained age at the time of the first withdrawal (after a wait period, if any). The older the policyholder is at the time of the first withdrawal, the higher the percentage that is allowed by the insurance company.

The benefit base is calculated similarly to other guarantees, and may incorporate Rollup and/or Ratchet designs. Depending on the evolution of the benefit base, the guaranteed withdrawals that are taken by the policyholder may increase over time. Note that the GLWB does not constitute an annuitization because the policyholder can still take advantage of potential increases in his or her underlying benefit base.

Once the policyholder's account value is fully depleted, the guaranteed withdrawals that are to be paid to the policyholder represent GLWB claim payments from the perspective of the insurance company. The modeling of this can be described as follows. The account value is projected according to the equity returns specified in each scenario. However, when the account value drops to zero, the GLWB claim is calculated as the present value of annual guaranteed withdrawal payments over the policyholder's remaining lifetime. In the event that the account value never drops to zero over the model projection horizon, the present value of future claims is compared with the current account value, and if higher, the difference is used as a proxy for the GLWB claim. This approximation is used to ensure a more reasonable model run time.

GLWB model assumptions

Base cell: Male, issue age 65 (sensitivities use issue ages 55 and 75)

Single premium: $50,000

Allocation: 100% to the S&P 500 Index

M&E assumption: 110 bps

Investment management fee: 100 bps with a 25 bps re-allowance, for all funds

Commission: 6% of initial premium, with no trail or charge-backs

Acquisition expenses: 100 bps of premium and $150 per policy

Maintenance expenses: $120 per policy, growing at 3% each year

Surrender charge schedule: 8%, 7%, 6%, 5%, 4%, 3%, 2%, 0% (% of account value)

Mortality: 80% of the Annuity 2000 Basic mortality table

Base Lapses: 1%, 1%, 2%, 3%, 4%, 5%, 8%, 20%, and 10% thereafter

GLWB design:
- Lifetime design, with a five-year wait (or deferral) period
- Ratchet/Rollup: Greater of the Annual Ratchet and the 5% compounded Rollup for five years, Annual Ratchet thereafter
- Maximum withdrawal benefit is set by the attained age at the time of the first withdrawal after the five-year wait period, and is locked in thereafter, i.e.:
  - 5% for life for ages 60-69
  - 6% for life for ages 70-79
  - 7% for life for ages 80-85

GLWB rider charge: 90 bps

GLWB dynamic lapse formula:
Factor = Min (100%, max (10%, 1 – 75% × [GLWB ITM – 110%])) where GLWB ITM = Present value of GLWB payments / account value

(and the present value is calculated using the 10-year Treasury rate)

GLWB elections: When withdrawals are available, a 100% election rate is assumed

Results and analysis

Under current statutory reserving methods, the GLWB rider is valued under AG 39. As discussed earlier, the statutory reserve for the GMIB equals zero because we are modeling new business and AG 39 is a retrospective accumulation of past charges (and there are none in this case).

Under current statutory reserving methods, the GLWB rider is valued under AG 39. The statutory reserve for the GMIB equals zero because we are modeling new business and AG 39 is a retrospective accumulation of past charges.

The base AG 43 and C-3 Phase II results are presented in Table 9 below. As before, the results shown represent the required reserves or capital amounts in excess of the cash surrender value, as of the issue date, expressed as a percentage of the initial account value.

TABLE 9: BASE AG 43 AND C-3 PHASE II RESULTS

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	4.4%	8.2%	0.0%	0.6%

As before, in order to gauge the variation in the stochastic and Standard Scenario results, sensitivities to the base case were performed. The results for these sensitivities, along with the accompanying discussion are presented below (see Tables 10-15).

TABLE 10: AGE 55 CELL / AGE 75 CELL

	AGE 55				AGE 75			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	4.7%	9.3%	0.0%	1.3%	2.4%	4.7%	0.0%	0.0%

CHANGE COMPARED TO THE BASE RESULTS - AGE 55 CELL / AGE 75 CELL

	AGE 55				AGE 75			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	+0.2%	+1.1%	-0.0%	+0.7%	-2.0%	-3.5%	-0.0%	-0.6%

TABLE 11: GUARANTEES ARE 10% AND 20% IN THE MONEY AT ISSUE

	GUARANTEES ARE 10% ITM AT ISSUE				GUARANTEES ARE 20% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	6.4%	10.4%	0.0%	1.6%	9.2%	13.1%	0.0%	2.7%

CHANGE COMPARED TO THE BASE RESULTS - GUARANTEES ARE 10% AND 20% IN THE MONEY AT ISSUE

	GUARANTEES ARE 10% ITM AT ISSUE				GUARANTEES ARE 20% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	+2.0%	+2.2%	-0.0%	+1.0%	+4.8%	+4.9%	-0.0%	+2.1%

TABLE 12: GUARANTEES ARE 30%, AND 40% IN THE MONEY AT ISSUE

	GUARANTEES ARE 30% ITM AT ISSUE				GUARANTEES ARE 40% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	12.5%	15.9%	0.0%	3.8%	16.4%	18.7%	1.4%	5.1%

CHANGE COMPARED TO THE BASE RESULTS - GUARANTEES ARE 30%, AND 40% IN THE MONEY AT ISSUE

	GUARANTEES ARE 30% ITM AT ISSUE				GUARANTEES ARE 40% ITM AT ISSUE			
	STOCHASTIC SCENARIO		STANDARD		STOCHASTIC SCENARIO		STANDARD	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	+8.1%	+7.7%	-0.0%	+3.3%	+11.9%	+10.5%	+1.4%	+4.5%

Only 50% of the Net Revenue-Sharing Income in the AG 43 CTE Amount calculation is contractually guaranteed (and therefore reflected)

TABLE 13: 50% REVENUE SHARING

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	4.5%		0.0%	

CHANGE COMPARED TO THE BASE RESULTS - 50% REVENUE SHARING

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	+0.1%		-0.0%	

- Increased longevity risk, as modeled by 50% of the base mortality assumption

TABLE 14: LONGEVITY RISK (50% OF BASE MORTALITY)

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	5.3%	9.3%		

CHANGE COMPARED TO THE BASE RESULTS - LONGEVITY RISK (50% OF BASE MORTALITY)

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	+0.9%	+1.1%		

- Reflection of simple hedging for the stochastic calculation using a 70% credit for the claims and assuming a 110 bps cost of the hedging program

TABLE 15: HEDGING (70% CREDIT, 110 BPS COST)

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	3.7%	4.4%		

CHANGE COMPARED TO THE BASE RESULTS - HEDGING (70% CREDIT, 110 BPS COST)

	STOCHASTIC		STANDARD SCENARIO	
	AG 43 (CTE 70)	C3P2 (CTE 90)	AG 43	C3P2
GLWB DESIGN	-0.7%	-3.8%		

Interestingly, the Standard Scenario results are markedly lower than the stochastic case, for both the base and all the sensitivity results, although it is important to point out that this observation may vary as the policy ages over time.

The Standard Scenario results are markedly lower than the stochastic case, for both the base and all the sensitivity results, although it is important to point out that this observation may vary as the policy ages over time.

However, for a newly issued policy, this observation is attributable to the fact that the modeled GLWB claims occur only after the account value drops to zero, an event that tends to be far out in the tail of the projection. At the time this event occurs, the model calculates the present value of all future guaranteed annual claim payments made over the policyholder's remaining lifetime, which represents a single point-in-time cash outflow (from the perspective of the insurance company). Note that this is the ONLY outflow for the Standard Scenario Net Revenue calculation—in all prior months, the Accumulated Net Revenue has been building up (that is to say, it never decreases) as a result of the in-flows captured in the Standard Scenario revenue margin calculation. Under C-3 Phase II, the latter essentially encompasses the GLWB rider charge and a 10 bps margin, whereas for AG 43, it encompasses the GLWB rider charge, a 20 bps margin, and any contractually guaranteed Net Revenue-Sharing Income. This clearly implies that the AG 43 Standard Scenario requirement is likely to be much less than that needed for the C-3 Phase II Standard Scenario, which is in agreement with the base results in Table 9.

Most of the sensitivities that have been modeled demonstrate similar patterns to the stochastic results for the GMDB/GMIB case study discussed earlier in this paper. An additional longevity risk sensitivity, which utilizes 50% of the base mortality assumption, shows that lower mortality results in somewhat higher requirements for both stochastic calculations, although there is virtually no impact on both Standard Scenario calculations, for the reasons outlined earlier.

REASONS WHY THE STANDARD SCENARIO MAY EXCEED THE STOCHASTIC REQUIREMENT

As suggested by the case studies, in certain circumstances it is possible that the reserving and capital requirements under both Standard Scenarios may exceed their respective stochastic counterparts.

The following observations offer a number of potential reasons why this might be the case.

- The specified lapse rates under the Standard Scenario may be higher than the prudent best estimate assumptions that are used (based on company experience) in the CTE Amount and TAR calculations. This will result in lower revenue margins under the Standard Scenario, which is only partially offset by the corresponding reduction in claim payments.

- The prescribed VAGLB election assumptions under the Standard Scenario (in the form of annuitizations for GMIBs or withdrawals for GMWBs) may be more conservative than the prudent estimate assumptions that are used (based on company experience) in the CTE Amount and TAR calculations. This will result in a higher incidence of claims for the Standard Scenario, and hence higher reserving and capital requirements.

- The prescribed mortality assumption implicit in the Standard Scenario is relatively higher than in the CTE Amount and TAR calculations. For a GMDB design, for example, this would result in lower revenue margins under the Standard Scenario and a higher incidence of claims. Note that GMIB claims would be reduced (because the in-force cohort that could potentially elect to annuitize is reduced as a result of the higher mortality decrement).

For VAGLBs where the wait period has expired or is close to expiry (relative to the valuation date) there is a greater impact in the calculation of the Standard Scenario because of the immediate drop that takes place at the valuation date.

- For VAGLBs where the wait period has expired or is close to expiry (relative to the valuation date) there is a greater impact in the calculation of the Standard Scenario because of the immediate drop that takes place at the valuation date.

- For contracts that are already deeply ITM at the valuation date, the immediate drop under the Standard Scenario further exacerbates the ITM level and results in higher projected claims. Under the stochastic calculation, the analogous situation may not occur until later on (and so results in a lower requirement on a present value basis), if at all.

- In the Standard Scenario calculation (for either AG 43 or C-3 Phase II), there is evidently a lack of consideration of the base contract (i.e., sans rider) profitability, in that not all base contract revenues and/or expenses are recognized. For example, neither surrender charges (a revenue component) nor commissions (an expense component) are included in Accumulated Net Revenue calculation for the Standard Scenario. In contrast, all such cash flows are included for the stochastic calculation. As a result, if the base contract itself is profitable, the Standard Scenario requirement may exceed the stochastic requirement.

- If none of the Net Revenue-Sharing Income is contractually guaranteed, then the likelihood is increased that the AG 43 Standard Scenario may result in a higher requirement than the CTE Amount calculation. This is because, in this case, there is no recognition of any Net Revenue-Sharing Income in the AG 43 Standard Scenario, and so the revenue margin that is calculated is correspondingly lower. Under the stochastic calculation, it is possible that this *loss* is mitigated somewhat by averaging over the many scenarios that are being modeled.

- As pointed out earlier, neither of the Standard Scenarios recognize the benefit of dynamic hedging, and so the requirement under the Standard Scenario may correspondingly be higher.

IMPACT OF AG 43 AND C-3 PHASE II ON FUTURE PRODUCT DESIGNS

As the above results suggest, product design can have a significant impact on both the reserving and capital requirements under AG 43 and C-3 Phase II, respectively. Certain designs appear to be more susceptible than others: Rollup designs, for example, face higher requirements than Ratchet designs, and GMIBs typically will have higher requirements than GMDBs.

Insurance companies that have written a substantial amount of variable annuities with rich guarantees, especially prior to the period encompassing the recent turmoil in the financial markets, are likely to face significant reserving and capital requirements because of the likelihood of these guarantees being deeply in the money.

Insurance companies that have written a substantial amount of variable annuities with rich guarantees, especially prior to the period encompassing the recent turmoil in the financial markets, are likely to face significant reserving and capital requirements because of the likelihood of these guarantees being deeply in the money.

Based on the GMDB/GMIB case study, it is quite possible that many companies will be forced to hold requirements based on the Standard Scenario floor (for these types of guarantees) rather than the stochastic requirement.

The current financial environment, which exhibits a combination of lower equity market levels and higher market volatility, is likely to have a significant impact on the development of new variable annuity products. Clearly richer benefits (from the perspective of the policyholder) that could potentially result in correspondingly higher requirements for the insurer are likely to be scaled back to more modest designs. The litmus test will involve how well insurance companies can design a profitable product with moderate reserving and capital requirements while at the same time still being able to offer a competitive product to consumers. The benefit cost of the underlying guarantees is another important aspect of developing a product, and one that insurance companies should consider in light of the current environment.

It is critical that insurance companies recognize that one of the simplest and easiest ways to reduce risk (and by extension, financial reporting requirements) during the product life cycle is by focusing on the front end of the product life cycle when products are first designed and priced.

Some potential avenues that can be incorporated up front in the design process by insurance companies to control reserving and capital requirements are detailed below.

It should be noted that some (if not all) of these aspects are already employed in the insurance industry; however, to the extent that they are not, companies could potentially be at risk for higher reserving and capital requirements.

- **Introduce longer wait periods for GMIB and GMAB designs.** A longer wait period allows for a greater interval over which the policyholder's account value can potentially grow (or balance out any losses). This in turn decreases the net amount at risk and likely reduces the severity of claims arising from the underlying guarantees. A longer wait period also gives the opportunity for additional revenue to be collected through both additional rider charges (which typically cease to be applicable after the rider is exercised) and additional M&E charges. The latter may occur by way of the longer wait period encouraging the policyholder to continue to hold the contract until the guarantee becomes available.

- **Using deductibles on the benefits available to the policyholder.** The convention in most variable annuity products is that the initial premium deposit is used to set up the guaranteed benefit amount, so that $100,000 of premium deposited means that a guaranteed benefit of $100,000 is correspondingly set up. For an Annual Ratchet design, say, in future years, the benefit at each anniversary is equal to the greater of the current account value and (100% of) the benefit value at the prior anniversary.

An alternative approach that would offer some protection to the insurance company would be to alter this relationship slightly using what is sometimes referred to as a *deductible*. For example, a 10% deductible assumption for an Annual Ratchet design would mean that the benefit available to the policyholder would equal the greater of the current account value and 90% of what would be available under a (normal) Annual Ratchet. A sample illustration of this is given in the table below, assuming an unfavorable equity scenario over a 10-year time horizon.

GMDB RATCHET ILLUSTRATION WITH A 10% DEDUCTIBLE

POLICY YEAR	EQUITY SCENARIO	ACCOUNT VALUE	GMDB RATCHET NO DEDUCTIBLE	GMDB RATCHET WITH DEDUCTIBLE	NAR – NO DEDUCTIBLE	NAR - WITH DEDUCTIBLE
		100,000	100,000	100,000	0	0
1	6%	106,000	106,000	106,000	0	0
2	-2%	103,880	106,000	103,880	2,120	0
3	3%	106,996	106,996	106,996	0	0
4	5%	112,346	112,346	112,346	0	0
5	-11%	99,988	112,346	101,112	12,358	1,123
6	-15%	84,990	112,346	101,112	27,356	16,122
7	-7%	79,041	112,346	101,112	33,306	22,071
8	12%	88,525	112,346	101,112	23,821	12,586
9	-2%	86,755	112,346	101,112	25,591	14,357
10	-3%	84,152	112,346	101,112	28,194	16,959

As is evident from the table above, there is no NAR for the policy with the 10% deductible until such time as the market declines sufficiently to result in the account value falling to less than 90% of the Annual Ratchet amount–a situation that occurs at the end of the fifth policy year. Note that in future policy years, the NAR with the 10% deductible is considerably less than the NAR if the deductible were not in place.

A lower NAR clearly means that the severity of GMDB claims will be reduced and the tail risk to the insurance company somewhat mitigated.

Note that a similar type of approach could be adopted for Rollup designs, simply by applying the percentage reduction to the (normal) Rollup guarantee value.

- **Establishing caps on the Rollup benefit available.** The cap is typically defined as a multiple of premiums paid less withdrawals.

Defining a cap on the Rollup benefit is thus a logical way to limit the risk to the insurance company. In particular, it has the advantage of limiting the severity of the low frequency of claims that typically arises under the Rollup feature, and will directly impact the tail of the loss distribution used for AG 43 and C-3 Phase II, resulting in lower reserving and capital requirements.

After the cap is reached, the Rollup guaranteed amount is not allowed to exceed the cap amount. Defining a cap on the Rollup benefit is thus a logical way to limit the risk to the insurance company. In particular, it has the advantage of limiting the severity of the low frequency of claims that typically arises under the Rollup feature, and will directly impact the tail of the loss distribution used for AG 43 and C-3 Phase II, resulting in lower reserving and capital requirements.

- **Placing restrictions on the sub-account funds available to policyholders.** The intent behind this strategy is to restrict participation in funds with high volatility that could potentially increase the benefit cost of the underlying guarantees, and thus likely increases in the reserving and capital requirements that would need to be held by the insurance company. The benefit cost can be quite sensitive to the

different types of fund allocations across sub-accounts. Generally, funds such as small cap funds and international funds have higher volatilities than other equity funds.
The strategy could be achieved either by barring access to these funds entirely or perhaps by mandating limits on the allocation of policyholder's account values to these funds. Alternatively, the insurance company could reduce the benefit cost by requiring a minimum level of participation in low-volatility funds such as bond funds and/or money market accounts.

By decreasing the benefit cost of the underlying guarantees, the insurance company is directly reducing the tail risk exposure that contributes to AG 43 and C-3 Phase II requirements.

- **Higher rider charges.** Although raising charges on the guarantee riders would generally reduce reserving and capital requirements as a result of the additional revenue that would be captured, such a strategy is likely to not keep the insurance company competitive in the eyes of consumers nor potentially be acceptable to regulators.

- **Defining asset based charges based on the benefit (or guarantee) rather than account value.** Historically, asset-based charges such as rider fees have been based on the account value. However, the account value may fluctuate considerably depending on the performance of the underlying sub-accounts that the policyholder is invested in, the implication being that the revenue collected from the rider charges that are applied to the account value could potentially fluctuate depending on how the account value is performing.

  In order for the insurance company to be able to collect a more stable pattern of revenue from the policyholder, an alternative strategy would be to apply the rider charge to the benefit value itself, which is apt to have a smoother pattern of growth over time because the value can only really ever increase or stay level over time (ignoring partial withdrawal activity). Another more aggressive variation would be to base the rider charge at all times on the higher of the benefit value and the account value.

  Note that changing the rider charge base is perhaps more justifiable than changing the M&E charge base. That is, from a regulatory perspective, it makes sense that the rider charge could be applied to the rider value itself, but the same is not true of the M&E charge, which is typically associated with the base contract (and hence the account value).

- **Avoiding overly generous guarantee types and product designs.** This is perhaps the most obvious route to take to reduce risk to the insurance company. However, for purposes of maintaining market share, it may be hard for some companies to avoid doing this, despite risk and profitability concerns.

- **Automatic allocation of funds to/from the variable and fixed accounts depending on market conditions.** Introduce products which automatically allocate money to/from the variable and fixed accounts depending on market conditions, so as to reduce risk to the policyholder (and the company).

- **Sensitivity test assumptions that are key drivers of results.** As with all actuarial activities, good practice would suggest stress testing the sensitivity of reserving and capital requirements with respect to certain assumptions that are deemed key drivers of results. This information may not directly impact financial reported results, but it would provide valuable risk management information for senior management that could potentially lead to better pricing and product design early in the product life cycle.

In order for the insurance company to be able to collect a more stable pattern of revenue from the policyholder, an alternative strategy would be to apply the rider charge to the benefit value itself, which is apt to have a smoother pattern of growth over time because the value can only really ever increase or stay level over time (ignoring partial withdrawal activity).

For example, performing immediate equity down shocks could provide useful information regarding *worst-case* scenarios, such as how a one-day market event shock would impact the in-force block of business.

Apart from attempting to control reserving and capital requirements by focusing on the pricing and design at the front end, certain approaches can also be adopted during the product life cycle that also serve to mitigate risk. Note that some of the above approaches may also be instituted after issue and not only at the pricing stage. However, some other approaches are outlined below.

- **Dynamic hedging.** In recent years, most variable annuity writers have set up some form of dynamic hedging program that hedges some combination of the delta (equity), rho (interest rate) and vega (volatility) risks that are generated by the liability. The target for the hedge is typically the change in the liability value, which may be the FAS 133 reserve or the economic reserve, for example. By hedging the movement in the liability using financial derivatives, the insurance company can minimize the volatility in financial results. In essence, hedging provides protection to the insurance company against adverse economic scenarios by sacrificing some of the gains that may be available to the company in favorable economic scenarios.

  Recognition of the actual hedging program in the CTE Amount and TAR calculations used for AG 43 and C-3 Phase II, respectively, is contingent on the hedging program meeting a variety of requirements that are specified in detail in the June 2005 and AG 43 document (and is not outlined in this paper). Note that a full-blown reflection of hedging in the model is unlikely to be optimal from a run time (or even a modeling) perspective. However, some reflection of the actual hedging program in the model, when deemed appropriate, is likely to reduce the C-3 Phase II requirement, although, as discussed earlier, it may have the opposite impact on the AG 43 reserving requirement.

  It is important to note that as in reality, reflecting hedging in the model calculations will only help so much because the company is also exposed to actuarial risks such as mortality and policyholder behavior (via lapses, partial withdrawals, and VAGLB elections) for which there is no capital market instrument that can be used to hedge the risk.

- **Developing prudent assumptions via monitoring and experience studies.** Monitoring policyholder behavior with respect to utilization of VAGLB features as well as developing experience studies for other assumptions such as mortality, lapses, and expenses are very important in developing prudent assumptions (with margins) that are required for modeling both AG 43 and C-3 Phase II. The results for the latter are likely to be quite sensitive to the setting of assumptions, especially for the utilization of guarantees.

It may be useful for the practitioner to produce a *movement* type of analysis, similar to that used for embedded value reporting, that summarizes the step-by-step assumption changes that may have occurred from one financial reporting cycle to the next, or when assumptions have been deemed to have materially changed, so as to gauge the impact of the updating of assumptions.

One other important observation that has not been discussed to date is the potential volatility in results that may occur due to periodic revision of the prudent estimate assumptions underlying the modeling. In the past, statutory valuation typically used assumptions that were locked in at issue and did not change over the life of the contract. However, both AG 43 and VACARVM allow for the revision of assumptions, assuming that such revisions can be justified by credible experience studies on the block of business that is under consideration. It may be useful for the practitioner to produce a movement type of analysis, similar to that used for embedded value reporting, that summarizes the step-by-step assumption changes that may have occurred from one financial reporting cycle to the next, or when assumptions have been deemed to have materially changed, so as to gauge the impact of the updating of assumptions.

APPENDIX 1 - CURRENT PROVISIONS FOR AG 43 (A DETAILED SUMMARY)

Guiding principles for the CTE Amount calculation (paraphrased)

1. Quantify the amount of statutory reserves that are needed so as to meet the contractual obligations based on risks the company is exposed to.

2. An analysis of asset and liability cash flows produced by the application of a stochastic cash flow model to equity return and interest rate scenarios should be used.

3. Prudent estimate assumptions, set on a holistic basis, should be applied.

4. Any modeling disconnects from reality should be adjusted for in the setting of the prudent estimate assumptions.

5. A model is only a model—and therefore only an approximation to reality. Moreover, all assumptions and risk management strategies that are used should be justifiable and not simply used to artificially reduce the calculated reserve.

CTE Amount - Assumptions and methodology

Assumptions

The assumptions to be used are required to be prudent estimate, meaning that the actuary needs to set them on a conservative basis, taking into account both the relevance, availability, and credibility of experience data.

From the practitioner's perspective, prudent estimate assumptions are developed by first considering the *anticipated experience* assumption (the actuary's reasonable estimate of future experience) and applying a margin to this to reflect uncertainty. Intuitively, the greater the degree of the uncertainty that the actuary feels may exist, the greater the margin that should be considered. Note that because these assumptions are meant to be conservative, such a margin should only serve to increase the reserve.

Assumptions should also be set on a holistic basis. For example, choosing a conservative prudent assumption for each assumption in the model may distort the overall risk profile; the actuary should instead attempt to set individual assumptions such that the overall or aggregate picture is reflective of the intended level of uncertainty, and is also consistent with the spirit of the guiding principles.

Further guidance on setting assumptions is provided in Appendix 9 and 10 of the AG 43 document.

Although the setting of assumptions for the AG 43 CTE Amount calculation is largely left to the judgment of the actuary, a specific limitation exists on the amount of Net Revenue-Sharing Income that is allowed to be reflected. Note that Net Revenue-Sharing Income is the amount of revenue from the fund managers that are managing the underlying sub-accounts that is due back to the insurance company, net of any expenses that may exist.

In particular, the actuary is required to estimate what portion of the overall Net Revenue-Sharing Income assumption is contractually guaranteed and what is noncontractually guaranteed. This split would typically be accomplished by an analysis of the contractual agreements that are in place as of the valuation date that support the payment of Net Revenue-Sharing Income to the company, with due consideration given

Although the setting of assumptions for the AG 43 CTE Amount calculation is largely left to the judgment of the actuary, a specific limitation exists on the amount of Net Revenue-Sharing Income that is allowed to be reflected.

to the recognition requirements that are laid out in Appendix 1.1A)E of the AG 43 document. Further guidance on revenue sharing is provided in the AAA document http://www.actuary.org/pdf/life/revenue_june06.pdf.

The contractually guaranteed component is recognized in the CTE Amount calculation in its entirety. However, the noncontractually guaranteed component is subject to limitations, in the form of a *haircut* and cap, as described below:

> The actuary's estimate of noncontractually guaranteed Net Revenue-Sharing Income *before* reflecting any margins for uncertainty multiplied by the haircut factor shown below:
> (i) 1.0 in the first projection year
> (ii) 0.9 in the second projection year
> (iii) 0.8 in the third projection year
> (iv) 0.7 in the fourth projection year
> (v) 0.6 in the fifth projection year
> (vi) 0.5 in the sixth and all subsequent projection years
>
> Moreover, the resulting amount of noncontractually guaranteed Net Revenue-Sharing Income after application of this factor shall not exceed a cap of 0.25% per year on separate account assets in the sixth and all subsequent projection years.

Modeling of policyholder behavior should assume that as the guarantee becomes more valuable to the policyholder, there is an increased likelihood that policyholders will persist rather than lapse.

Finally, policyholder behavior assumptions, as simulated by formulas in the stochastic model, are likely to significantly affect the CTE Amount results. Modeling of policyholder behavior should assume that as the guarantee becomes more valuable to the policyholder, there is an increased likelihood that policyholders will persist rather than lapse. These assumptions should be developed carefully from relevant, available, and fully credible data, consistent with the conservatism required for prudent estimate assumptions. In particular, certain guarantees (such as GMIB and/or GMWB designs with built-in waiting periods) may have limited experience data to draw upon, and so the actuary should be careful in attempting to use such data to justify formulas in the model.

Note that all supporting experience data and analysis used to develop assumptions (not only limited to policyholder behavior) should be outlined in a supporting memorandum that is required by AG 43, as is laid out in Appendix 8 of the AG 43 document.

Discount rates

The discount rates to be used for the CTE Amount calculation are the interest rates at which positive cash flows are invested, reduced to reflect any expected credit losses and ignoring any tax adjustment. These interest rates may be based on one of the following:

1. Forward interest rates implied by the swap curve that is in effect as of the valuation date. These rates are for a fixed rate payer in return for receiving three-month LIBOR, and can be found at http://www.federalreserve.gov/releases/h15/default.htm.

2. Interest rate scenarios from the C-3 Phase I scenario set coupled with the chosen equity return scenarios.

3. An *integrated model* of equity return and interest rate scenarios. This means that the equity separate account returns and interest rates are developed inter-dependently.

Certain restrictions on any movements from one of the above interest rate assumptions to another assumption exist, should the practitioner decide to change assumption from one year to the next.

Scenarios

There are several possibilities as to the development of scenario to be used for the stochastic calculation. The actuary may use a subset of the 10,000 prepackaged real-world asset scenarios published by the American Academy of Actuaries, where the subset can be generated from the scenario picking tool that is also provided. These scenarios contain both stochastic equity returns and stochastic interest rates. Alternatively, a scenario set may be generated using either an in-house or proprietary stochastic model.

In either case, the equity returns that are used should produce accumulation factors (referred to as Gross Wealth Ratios) that meet the scenario calibration criteria specified in Appendix 5 of the AG 43 document. Although we refer the reader to this document for more specific detail on the exact requirements, these criteria are designed to ensure that the scenarios that are used reflect sufficient conservatism so as not to understate the level of tail risk that exists.

The number of scenarios that should be used for the CTE Amount calculation is left to the judgment of the actuary, but with the usual understanding that applies in stochastic modeling that, should any additional scenarios be used, the resulting CTE Amount is not materially different.

Hedging

Any existing hedges (as of the valuation date) may be run off. Moreover, if the company is following a dynamic hedging strategy that 1) can be classified as a Clearly Defined Hedging Strategy (CDHS) as specified in Section III of the AG 43 document, and 2) meets the requirements outlined in Appendix 7 of the AG 34 document, then the CTE Amount may be reduced to reflect the impact of hedging.

Note that before a new or revised hedging strategy can be reflected in the CTE Amount calculation, the hedging strategy should either be live (that is, in place by the insurance company) or mock tested for at least three months.

Also, any risk offsetting with lines of business covering products that are not in-scope with respect to AG43 is not permitted.

The reflection of the actual hedge modeling in the CTE calculation uses a credibility-based approach. The first step in this approach calculates a CTE Amount (Best Efforts), which incorporates the hedging strategies into the projected cash flows. The second step involves recalculating the CTE Amount assuming the company has no dynamic hedging—that is, the only impact to cash flows is from run-off from the hedge positions that exist on the company's books as of the valuation date. This amount is referred to as the CTE Amount (Adjusted). The reported value for the CTE Amount is then as follows:

$$\text{CTE Amount (Reported)}$$

$$= E \times \text{CTE Amount (Best Efforts)} + (1 - E) \times \text{CTE Amount (Adjusted)}$$

In the above, E is an effectiveness (or credibility-like) factor that reflects, in the actuary's judgment, the level of sophistication associated with how well the actual dynamic hedging is being reflected in the model, and in particular, the asset and liability Greeks.

The following are requirements placed on the value of E, as outlined in the AG 43 document.

- E is not allowed to exceed 70%.
- If hedge cash flows are not modeled directly, E is not allowed to exceed 30%.
- Simplistic reflections of hedge cash flows will have a value of E in the low range between 0% and 70%.
- As sophistication of the model increases, one would expect the value for E to increase.
- The insurance company is required to demonstrate that, based on the prior year's historical data, the model is able to replicate the hedging strategy in a way that justifies the value used for E. If such historical data is not available (or does not exist), a value for E of no greater than 30% can be assumed.

Certification that demonstrates that the calculation of E, CTE Amount (Reported) and CTE Amount (Best Efforts) is consistent with the methodology outlined AG 43 document is also required.

A *reinsurance approach* to modeling hedging is quite often used by insurance companies to approximately reflect dynamic hedging in financial reporting models.

A *reinsurance approach* to modeling hedging is quite often used by insurance companies to approximately reflect dynamic hedging in financial reporting models. In this approach, excess guaranteed claims that are required to be paid by the insurance company to policyholders are offset by cash income in the form of hedge instrument payoffs of an amount equal to some percentage of these claims. This percentage represents the effectiveness of the hedge, in terms of what proportion of overall excess claims are covered by the program. At the same time, there is an additional cash outgo that is reflected in the model that represents the cost of the hedging program to the insurance company.

This approach is quite simple to model, but it is important to note that it will not realistically reflect the impact of the actual dynamic hedging program. In particular, this approach:

- does not reflect the fact that actual dynamic hedging programs typically use financial derivatives to hedge against the change in a target quantity, such as fair value, economic reserve or FAS 133 reserve attributable to the guarantee
- does not explicitly reflect any asset or liability Greeks (of the above targets)

For these reasons, one would expect that the value of E that would be assigned to this approach would be low, perhaps at most 30%.

Most financial reporting models, such as for AG 43 and/or C-3 Phase II, will (for model run time concerns) typically involve some approximation for dynamic hedging that is similar to (or perhaps moderately more complex than) the above reinsurance approach, rather than a full-blown dynamic hedging calculation that calculates asset and liability Greeks.

Standard Scenario floor

For a given contract with guaranteed benefits, the Standard Scenario Reserve is calculated using the following quantities:

1. The Cash Surrender Value

2. The Basic Adjusted Reserve (defined below)

3. The Greatest Present Value at the end of each projection year of – Accumulated Net revenue, floored at 0

   — Net Revenue is the revenue produced by prescribed margins on the account value during the projection year, less guaranteed benefit payments in excess of account value and any individual reinsurance, accumulated to the end of that projection year.

   — Accumulated Net Revenue is the accumulated equivalent of Net Revenue for the prior projection year (with interest equal to the discount rate), in addition to the Net Revenue for the current projection year. It is thus analogous to a typical surplus calculation.

4. This particular contract's allocation of the value of hedges and aggregate reinsurance

The Standard Scenario Reserve is then calculated as max [(1), (2) + (3) - (4)].

The Basic Adjusted Reserve above is the reserve that is obtained by applying statutory valuation requirements that were applicable immediately prior to the adoption of AG 43 (referred to as the Basic Reserve), as well as the additional requirement that free partial withdrawal provisions are to be ignored when determining surrender charges.

For contracts without guaranteed benefits, the Standard Scenario Reserve is equal to the Basic Reserve.

Assumptions

Both the drop and recovery assumptions applied to the account value as discussed above vary depending on the asset classes that the policyholder is invested in, and are detailed below:

AG 43 STANDARD SCENARIO – GROSS RETURN ASSUMPTIONS

	INITIAL	PROJECTION YEAR 1	PROJECTION YEARS 2 – 5	PROJECTION YEAR 6+
EQUITY CLASS	-13.5%	0%	4.00%	5.50%
BOND/MONEY MARKET CLASS	0%	0%	4.85%	4.85%
BALANCED CLASS	-8.1%	0%	4.34%	5.24%
ANY FIXED SEPARATE ACCOUNTS AND GENERAL ACCOUNT	0%	FIXED FUND RATE	FIXED FUND RATE	FIXED FUND RATE

As is evident from the above table, the actuary will need to map the various sub-accounts that comprise the policyholder's total account value into the equity, bond, balanced, or fixed account classes in order to model the drop and recovery. It is important to note that the above returns are gross returns, so contract charges and fund charges will need to be deducted so as to project out future account values.

The actuary will need to map the various sub-accounts that comprise the policyholder's total account value into the equity, bond, balanced, or fixed account classes in order to model the drop and recovery.

The fixed fund rate above is the greater of the contractually guaranteed minimum interest rate, floored at 4%, and capped at the current credited rates on fixed funds as of the valuation date.

The annual margins on account value that are used to produce the revenue component of the Standard Scenario Reserve are defined in the AG 43 documentation as follows, where SC period refers to the surrender charge period and NRSI refers to the Net Revenue-Sharing Income. There are two Standard Scenario margins, one applied to the separate account value and one applied to the fixed account value.

SS Margin applied to SA AV = Margin A if within the SC period
= Margin B otherwise

SS Margin applied to FA AV = Margin A if within the SC period
= max (40 bps, Margin B) otherwise

where

Margin A (within the surrender charge period)

A = 20 bps of AV + contractually guaranteed NRSI
+ max (20 bps, VAGLB charges) + max (20 bps, GMDB charges)

Margin B (after the SC period)

B = Margin A + 50% * max (0, Total Charges – [A – contractually guaranteed NRSI])

and A is as defined in Margin A.
Total charges equals the M&E charge plus the applicable rider charges

Note that Margin A, which is during the surrender charge, reflects a lower level of margins (on a % basis) as compared to Margin B, which is after the surrender charge period. Further, only contractually guaranteed Net Revenue-Sharing Income is recognized in the margins; there is no reflection of non-contractually guaranteed Net Revenue-Sharing Income.

The mortality assumed for the Standard Scenario calculation is 70% of the 1994 MGDB tables through age 85, increasing by 1% each year to 100% of the tables at age 115.

For exercisable VAGLBs other than GMWBs, the specified election rate to utilize the elective guaranteed benefit is a function of the in-the-moneyness (ITM) of the guarantee, as shown in the table below,

ELECTION RATE ASSUMPTIONS FOR THE STANDARD SCENARIO

VAGLB ITM	ANNUAL ELECTION RATE
ITM < 10%	5%
10% ≤ ITM < 20%	15%
ITM ≥ 20%	25%

unless the exercise of the guaranteed benefit would result in the loss of a richer VAGLB (for those contracts with multiple benefits), in which case the election rate is equal to 0.

Further, the election rate for an exercisable ITM guaranteed living benefit shall be 100% at the last projected model duration to elect such benefit.

For GMWBs, utilization of the elective guarantee is represented by a partial withdrawal equal to the applicable percentage in the table below applied to the contract's maximum allowable partial withdrawal. However, if this calculated partial withdrawal is less than the contractually guaranteed minimum partial withdrawal, the latter is assumed for the Standard Scenario calculation.

GMWB WITHDRAWAL/UTILIZATION ASSUMPTIONS UNDER THE STANDARD SCENARIO

	ATTAINED AGE LESS THAN 50	ATTAINED AGE 50 TO 59	ATTAINED AGE 60 OR GREATER
WITHDRAWALS DO NOT REDUCE OTHER ELECTIVE GUARANTEES THAT ARE ITM	50%	75%	100%
WITHDRAWALS REDUCE ELECTIVE GUARANTEES THAT ARE ITM	25%	50%	75%

Other than the above systematic withdrawals under a GMWB (which are contractually guaranteed), no partial withdrawals, including free partial withdrawals, are to be deducted from the account value.

Lapse assumptions for the Standard Scenario vary by type of guarantee. In particular, for GMDB-only contracts and VAGLB contracts that are out-of-the-money, the lapse rate depends on whether or not the contract is in the surrender charge period. However, for VAGLB contracts that are ITM, the lapse rate also depends on the ITM band if outside the surrender charge period.

Lapse assumptions for the Standard Scenario vary by type of guarantee. In particular, for GMDB-only contracts and VAGLB contracts that are out-of-the-money, the lapse rate depends on whether or not the contract is in the surrender charge period.

LAPSE ASSUMPTIONS UNDER THE STANDARD SCENARIO

	DURING SC PERIOD	AFTER SC PERIOD		
GMDB ONLY CONTRACTS	5%		10%	
ALL VAGLB CONTRACTS (IF OTM)	5%		10%	
		ITM < 10%	10%<= ITM< 20%	20%<=ITM
GMAB (IF ITM)	2%	2%	0%	0%
VAGLB CONTRACTS (IF ITM)	3%	7%	5%	2%

In order to properly define ITM for contracts with guaranteed benefits, the concept of a Current Value is introduced. The following represents guidance provided for the calculation of this value.

- The Current Value of the VAGLB is the amount of the current lump-sum payment (if exercisable) OR the present value of future lump-sum or income payments.
  - The discount rate here is the Standard Scenario discount rate.
  - If income payments are life contingent (either the right of future exercise or the right to future income benefits expire on death), the Standard Scenario mortality assumptions used for decrements applies as well.
- If a VAGLB is exercisable at the valuation date, its Current Value is determined assuming immediate/continued exercise of that benefit.
- If a VAGLB is not exercisable at the valuation date, its Current Value is determined assuming exercise at the earliest possible future time.
  - Assuming that survival up to the point of exercise is required to collect the benefit, this survival is reflected using the Standard Scenario mortality.
- Specifically, for an unexercised GMIB:

— The Current Value is determined as the option with a reserve closest to the reserve for a life and 10-year certain annuity. The discount rate here is the Standard Scenario discount rate. For the life-contingent portion of the payments, the Annuity 2000 Mortality Table is applied.
— However, the Current Value is set equal to the account value if the contract holder can receive higher income payments on exercise by electing the same option under the normal settlement option provisions of the contract.

With the Current Value defined as above, then

$$\text{ITM} = 100 \times [\text{Current Value of VAGLB} / \text{Account Value} - 1]$$

Both the Current Value and Account Value in the above formula are to use the beginning of period timing. Note that if a contract has multiple living benefit guarantees, then the guarantee having the largest Current Value shall be used to determine the percent in the money.

Last, no future deposits to account value shall be assumed unless required by the terms of the contract

Discount rates

The discount rate for the Standard Scenario is defined to be the valuation interest rate under the SVL for annuities that are valued on an issue-year basis, using Plan Type A with guaranteed duration greater than 10 but not more than 20 years.

Note that the discount rate for the Standard Scenario is defined to be the valuation interest rate under the SVL for annuities that are valued on an issue-year basis, using Plan Type A with guaranteed duration greater than 10 but not more than 20 years. The presence of interest guarantees and/or cash settlement options (as is indicated by the contract that is being modeled) is to be further used to determine the specific valuation interest rate to be used. The rationale for using this formulation was that VAGLBs generally have long waiting periods, so a guaranteed duration of 10 years is suitable. For 2008, note that the above interest rate would be equal to 5%, regardless of whether or not interest guarantees and/or cash settlement options are present.

Hedging

Only *approved* hedges existing as of the valuation date are reflected in the calculation. Further guidance is given in the AG 43 documentation for what constitutes an approved hedge. In the Standard Scenario cash-flow projections, such hedges that expire within a year after the valuation date should be based on holding the hedges to their expiration. Those hedges that expire further out should be valued based on liquidation one year from the valuation date.

Note that no impact due to dynamic hedging (that otherwise might be reflected in the CTE Amount calculation) is incorporated.

The value for these approved hedges is captured in the general Standard Scenario Reserve calculation (as described above), and is not part of the Net Revenue determination. In particular, the value for the approved value is the difference between

a. the discounted value at the 1-year constant maturity Treasury rate as of the valuation date of the pre-tax cash flows from the hedges, and
b. their statement values on the valuation date

Other requirements

Model granularity

For the purposes of model run time, the CTE Amount calculation is typically performed on a model office or grouped basis (given the stochastic scenario requirement). Care should be taken to ensure that the net amount at risk with respect to the guaranteed benefits, as aggregated policy by policy in a seriatim in-force file, is comparable to a similar calculation performed on the model office/grouped in-force file.

The Standard Scenario Amount calculation is required to use a seriatim in-force file. Moreover, if the CTE Amount calculation is performed on a grouped basis, then in addition to the Standard Scenario Amount being calculated on a seriatim basis, it must also be calculated on a grouped basis. The ratio of the Standard Scenario seriatim result to the grouped result must then be compared to one in order to gauge the reasonableness of the grouping that has been implemented.

The Standard Scenario Amount calculation is required to use a seriatim in-force file. Moreover, if the CTE Amount calculation is performed on a grouped basis, then in addition to the Standard Scenario Amount being calculated on a seriatim basis, it must also be calculated on a grouped basis.

Reinsurance

Because the Aggregate Reserve is determined net of any reinsurance, the calculations that are used to derive the Aggregate Reserve should also be net of reinsurance. This means that both the CTE Amount and the Standard Scenario Amount should be calculated on a net-of-reinsurance basis. Note that for financial reporting reasons, it may be necessary to calculate the Aggregate Reserve both prior to reinsurance and after reinsurance. This can be accomplished by ignoring any reinsurance premiums and recoveries that may be applicable.

For the Standard Scenario amount calculation, individual reinsurance premiums and recoveries should be included in the projected Net Revenue calculation. Individual reinsurance is defined as reinsurance where the total premiums for and benefits of the reinsurance may be determined by applying the reinsurance terms for a particular contract covered under the reinsurance treaty without reference to similar quantities of any other contract that is covered. The total effect is then simply summed across all contracts.

On the other hand, aggregate reinsurance (defined to be reinsurance that is not on an individual basis) is not reflected in the projected Net Revenue calculation. Instead, the value of aggregate reinsurance is the discounted value of the excess of the projected reinsurance benefits over the projected gross reinsurance premiums for contract covered by this reinsurance, in aggregate.

APPENDIX 2 - DIFFERENCES BETWEEN AG 43 AND C-3 PHASE II (A DETAILED SUMMARY)

Applicability

The various working groups responsible for the development of both C-3 Phase II and AG 43 have recommended that the product scope for both standards is intended to be the same. However, one slight exception to this is that AG 43 is applicable for all contracts issued on or after Jan. 1, 1981. In contrast, all issue years for in-scope contracts are covered under C-3 Phase II.

Differences with respect to the Stochastic calculation

The Conditional Tail Expectation Amount (CTE Amount) referenced in the AG 43 document is similar to the Total Asset Requirement (TAR) referenced in the C-3 Phase II RBC requirement. The difference in terminology masks the (largely) similar process that is used to come up with the result. Practitioners will sometimes refer to either quantity as the *stochastic* result, where the purpose at hand determines which of the CTE Amount or TAR is understood to be relevant.

Treatment of Federal Income Taxes (FIT)

The CTE Amount calculation for AG 43 is on a pre-tax basis, whereas the TAR calculation for C-3 Phase II is on a post-tax basis.

Specifically, under AG 43, Accumulated Deficiencies are calculated using underlying cash flows projected without consideration of FIT. Moreover, the calculation of the Scenario Greatest Present Value for a particular scenario is calculated using discount rates that are not reduced for FIT.

The corresponding TAR calculation under C-3 Phase II does reflect FIT in both the underlying projection of cash flows and in the discount rates that are used.

CTE Metric

The CTE Amount calculation for AG 43 employs a CTE 70 metric, focusing on the arithmetic average of 30% of the worst results. In contrast, the TAR calculation for C-3 Phase II employs a CTE 90 metric, focusing on the arithmetic average of 10% of the worst results.

The higher CTE percentile for capital requirements is due to the (comparatively) more stringent regulatory requirements for capital adequacy than for reserving.

The higher CTE percentile for capital requirements is due to the (comparatively) more stringent regulatory requirements for capital adequacy than for reserving. In most situations, one would expect that the CTE 90 calculated under C-3 Phase II would exceed the CTE 70 calculated under AG 43. However, it is possible for the reverse to be true in certain cases.

Revenue Sharing

Under AG 43, a limitation exists on the amount of Net Revenue-Sharing Income that is allowed in the CTE Amount calculation.

The actuary needs to be able to decompose this overall revenue sharing into a component that is contractually guaranteed and a component that is noncontractually guaranteed. The actuary should be prepared to justify (with supporting evidence) the amount of the contractually guaranteed portion that is assumed.

For the CTE Amount calculation, the former component is recognized in its entirety, while the latter is subject to a declining haircut over time and an eventual cap, as described in greater detail in the main body of this paper. This restriction is conservative in that it potentially increases the Accumulated Deficiencies in the AG 43 stochastic calculation, should some noncontractually guaranteed Net Revenue-Sharing Income exist.

Note that no such limitation to the Net Revenue-Sharing Income exists for the TAR calculation under C-3 Phase II–that is, all such income (whether contractually guaranteed or not) is fully recognized in the cash flows that are projected in the stochastic calculation.

Unlike its stochastic counterpart, the AG 43 Standard Scenario calculation only recognizes contractually guaranteed Net Revenue-Sharing Income in the revenue margins, and does not include any noncontractually guaranteed revenue sharing at all. This is in contrast with the C-3 Phase II Standard Scenario calculation, where Net Revenue-Sharing Income (in any form) is not included at all in the revenue margins.

Unlike its stochastic counterpart, the AG 43 Standard Scenario calculation only recognizes contractually guaranteed Net Revenue-Sharing Income in the revenue margins, and does not include any noncontractually guaranteed revenue sharing at all.

Assumptions

The CTE Amount calculation under AG 43 utilizes prudent estimate assumptions, whereas the TAR calculation under C-3 Phase II requires prudent best estimate assumptions. No real practical difference exists between these types of assumptions; they should both be conservatively set, and should incorporate a margin for uncertainty. Prior exposure drafts of the AG 43 document used the term *prudent best estimate*, and this was changed to *prudent estimate* only recently, ostensibly to align terminology with that used in the life product reserving guidelines.

Although it is largely expected that practitioners will utilize the same model assumptions for the CTE Amount and TAR calculations–which is consistent with the spirit of both AG 34 and C-3 Phase II–there is nothing that prevents different assumptions from being used, so long as these assumptions can be justified and supported by appropriate experience.

Discount Rates

The discount rates for the CTE Amount calculation under AG 43 are equal to the interest rates at which positive cash flows are invested. As described in the prior section, three possibilities for these interest rates are allowed under AG 43:

- forward interest rates implied by the swap curve in effect as of the valuation date
- interest-rate scenarios from the C-3 Phase I scenario set coupled with the chosen equity return scenarios
- an *integrated model* of equity return and interest rate scenarios.

It is important to note that the above would be on a pre-tax basis (that is, the interest rates should not be decreased for FIT) and should be reduced to reflect expected credit losses.

Under the TAR calculation, however, the practitioner is given a choice between either using the forward interest rates implied by the swap curve in effect as of the valuation date or 1-year Treasury rates from an integrated model. Either choice would be reduced via a FIT adjustment and a reflection of expected credit losses.

Hedging

Although the hedging approaches for both AG 43 and C-3 Phase II are quite similar, there are a number of differences.

As discussed in the prior section, under AG 43, the reported value for the CTE Amount is given by:

$$\text{CTE Amount (Reported)} = E \times \text{CTE Amount (Best Efforts)} + (1 - E) \times \text{CTE Amount (Adjusted)}$$

Under C-3 Phase II however, the reported value for the TAR is given by:

$$\text{TAR Amount (Reported)} = \text{TAR (Best Efforts)} + F \times \max(0, \text{TAR (Adjusted)} - \text{TAR (Best Efforts)})$$

In both cases, E and F are effectiveness (or credibility-like) factors.

Assuming that TAR (Adjusted) exceeds TAR (Best Efforts), which is the case if the modeled hedge strategy is improving (i.e., lowering) the stochastic requirement, then both these approaches are directly analogous if we set $F = 1 - E$. To the extent that this is not the case, then the formulas above are not comparable.

Under AG 43, the maximum value assigned to E is a value of 70%. Under C-3 Phase II, the minimum value assigned to F is 5%, which equates to an analogous E value of 95%.

There are also more restrictions placed on the effectiveness factor in the AG 43 documentation as compared with the C-3 Phase II instructions.

Standard Scenario

Discount rate definition

Under C-3 Phase II, the discount rate is the annual effective equivalent of the 10-year constant maturity Treasury rate for the month of valuation plus 50 basis points. This rate is floored at 3% and capped at 9%.

For AG 43, the discount rate is the rate defined under the SVL for annuities, as outlined in the prior section.

Drop and recovery

The drop and recovery assumptions are slightly different for AG 43 versus C-3 Phase II. The assumptions for the latter are given in the table below.

	INITIAL	PROJECTION YEAR 1	PROJECTION YEARS 2+
EQUITY CLASS	-20.0%	0%	3.00%
BOND/MONEY MARKET CLASS	0%	0%	4.85%
BALANCED CLASS	-12.0%	0%	3.74%
ANY FIXED SEPARATE ACCOUNTS AND GENERAL ACCOUNT	0%	FIXED FUND RATE	FIXED FUND RATE

In particular,

- Under C-3 Phase II, the drops for the Equity and Balanced classes are greater (more of an unfavorable shock), and the recovery returns for these classes are lower. Both of these observations make sense given the higher level of conservatism implicit in determining capital requirements (as opposed to reserves).
- For the recovery returns, there is no distinction between projection years 2-5 versus projection year 6+ under C-3 Phase II.
- The fixed fund rate under C-3 Phase II is defined as the greater of the contractually guaranteed minimum interest rate, floored at 4%, and capped at the current credited rates on fixed funds as of the valuation date. The AG 43 definition is similar; however, the floor is 3.5% rather than 4%.

Revenue margin

There are several subtle differences for the revenue margin calculation.

- Under AG 43, as defined in the previous section, the definition of Margin A uses a 20 bps of account value component in the margin calculation. However, under C-3 Phase II, the analogous component is equal to 10 bps.
- Under AG 43, in the definition of Margin A, contract charges are split into VAGLB and GMDB components, which are each compared to a 20 bps floor. However, under C-3 Phase II, the analogous component compared total contract charges to a 20 bps floor.
- Under AG 43, the definition of Margin A includes contractually guaranteed Net Revenue-Sharing Income. However, under C-3 Phase II, no Net Revenue-Sharing Income is recognized in the margin calculation.
- Under AG 43, there is no 65 bps cap applied as part of the Margin B calculation.

Under AG 43, the definition of Margin A includes contractually guaranteed Net Revenue-Sharing Income. However, under C-3 Phase II, no Net Revenue-Sharing Income is recognized in the margin calculation.

Mortality

Under AG 43, the mortality assumed for the Standard Scenario calculation is 70% of the 1994 MGDB tables through age 85, increasing by 1% each year to 100% of the tables at age 115.

For C-3 Phase II, the factor is 80% through age 95, increasing by 1% each year to 100% of the tables at age 115.

All things being equal, higher mortality is associated with reduced mortality and expense charges and lower VAGLB claims (somewhat offset by higher GMDB claims), and an overall reduction in profits. As before, this difference is reflective of the conservatism associated with determining capital requirements.

Lapses/ITM

In general, AG 43 assumptions are viewed as more developed and more consistent with emerging recommendations. In contrast, the C-3 Phase II assumptions that are outlined in both the June 2005 documentation and subsequent NAIC RBC interest risk and market risk instructions are in some sense older. An example of this are the instructions associated with defining Current Value, with respect to ITM and lapse rates.

In general, AG 43 assumptions are viewed as more developed and more consistent with emerging recommendations.

The guidance provided with respect to this in the AG 43 document, and specifically relating to the definition of Current Value is quite detailed, whereas the analogous instructions for C-3 Phase II are not.

The ITM definition is also different. For example, under C-3 Phase II, the definition is consistent with:

$$ITM = 100 \times [1 - \text{Account Value} / \text{Current Value of VAGLB}]$$

whereas under AG 43, the definition is

$$ITM = 100 \times [\text{Current Value of VAGLB} / \text{Account Value} - 1]$$

From a practical perspective, the actuary is unlikely to use a different definition for the ITM for both purposes.

Last, the lapse assumption is slightly different for ITM GMAB contracts under the Standard Scenario–in particular, during the surrender charge period under AG 43 the lapse rate for these contracts is equal to 2%, and after the surrender charge period and assuming the contract is less than 10% ITM, the lapse rate is also 2%. The corresponding lapse assumption under C-3 Phase II is 0% in both cases.

Election rates

Under AG 43, the election rate varies by ITM as described in the prior section. However, under C-3 Phase II, the Standard Scenario election rate is 15% for all ITM bands.

APPENDIX 3 – CASE STUDY GENERAL ASSUMPTIONS

Both GMDB/GMIB and GLWB models are profits-retained models. In particular, surplus accumulates (and is not released to shareholders) over the projection period.

Discounting

C-3 Phase II TAR: Utilizes the (after-tax) 1-year Treasury rates from each scenario.

VACARVM CTE: For simplicity, this utilizes the (pre-tax) 5-year Treasury rates from each scenario, less a 75 bps assumed spread.

C-3 Phase II Standard Scenario: Utilizes the annual effective equivalent of the 10-year constant maturity Treasury rate plus 50 basis points. This rate is floored at 3% and capped at 9%.

VACARVM Standard Scenario: Utilizes a (pre-tax) discount rate of 5%. This is the valuation rate for 2008 under the SVL for annuities that are valued on an issue-year basis, using Plan Type A with guaranteed duration greater than 10 but not more than 20 years.

Taxes

35% for C-3 Phase II projections, 0% for AG 34 projections.

Economic scenarios

1,000 real-world equity-return and interest-rate scenarios generated from the scenario picking tool published by the American Academy of Actuaries for the C3 Phase II prepackaged asset scenarios. The picked scenarios satisfy the wealth ratio criteria stipulated by both C-3 Phase II and AG 43.

Hedging

No hedging was assumed in the base case for either case study. However, as a sensitivity for each, the GMDB and GMIB Rollup/Ratchet product combination used a hedge effectiveness of 70% (for the guarantees), coupled with an assumed hedge cost of 130 bps, while the GLWB product used a hedge effectiveness of 70% (for the guarantees), coupled with an assumed hedge cost of 110 bps.

Model horizon

30 years was assumed.

1301 Fifth Avenue, Suite 3800
Seattle, WA 98101
(206) 624-7940

www.milliman.com