## VM-21: Requirements for Principle-Based Reserves for Variable Annuities

### Section 3: Reserve Methodology

1. General Description

The aggregate reserve for contracts falling within the scope of these requirements shall equal the stochastic reserve but not less than the standard projection amount, where the aggregate reserve is calculated as the standard projection amount plus the excess, if any, of the stochastic reserve over the standard projection amount plus the reserve for any contracts determined using the Alternative Methodology (following the requirements of Section 7).

1. Alternative Methodology

For variable deferred annuity contracts that contain either no guaranteed benefits or only GMDBs (i.e., no VAGLBs), the CTE amount may be determined using the alternative methodology described in Section 6 rather than using the approach described in Sections 3.C and 3.D. However, in the event the approach described in Sections 3.C and 3.D has been used in prior valuations, the Alternative Methodology may not be used without approval from the domiciliary commissioner.

The CTE amount for the group of contracts to which the Alternative Methodology is applied shall not be less than the aggregate cash surrender value of those contracts.

### Section 6Section 7: Alternative Methodology

A. General Methodology

1. General Methodology Description

For variable deferred annuity contracts that either contain no guaranteed benefits or only GMDBs, including “earnings enhanced death benefits,” (i.e., no VAGLBs), the reserve may be determined by using the method outlined below rather than by using the approach described in Section 3.D (i.e., based on projections), provided the approach described in Section 3.D has not been used in prior valuations or else approval has been obtained from the domiciliary commissioner.

The reserve determined using the Alternative Methodology for a group of contracts with GMDBs shall be determined as the sum of amounts obtained by applying factors to each contract in force as of a valuation date and adding this to the contract’s cash surrender value. The amount that is added to an individual contract’s cash surrender value may be negative, zero or positive, thus resulting in a reserve for a given contract that could be less than, equal to or greater than the cash surrender value. The resulting reserve in aggregate shall not be less than the greater of the cash surrender value or the reserve determined by applying VM-C-33, each in aggregate for the group of contracts to which the Alternative Methodology is applied.

The reserve determined using the Alternative Methodology for a group of contracts that contain no guaranteed benefits shall be determined using an application of VM-C-33, as described below.

**Guidance Note:** The term “contracts that contain no guaranteed benefits” means that there are no guaranteed benefits at any time during the life of the contract (past, present or future).

For purposes of performing the Alternative Methodology, materially similar contracts within the group may be combined together into subgroups to facilitate application of the factors. Specifically, all contracts comprising a “subgroup” must display substantially similar characteristics for those attributes expected to affect reserves (e.g., definition of guaranteed benefits, attained age, contract duration, years-to-maturity, market-to-guaranteed value, asset mix, etc.). Grouping shall be the responsibility of the actuary but may not be done in a manner that intentionally understates the resulting reserve.

2. Definitions of Terms Used in This Section

a. Annualized Account Charge Differential: This term is the charge as percentage account value (revenue for the company) minus the expense as percentage of account value.

b. Asset Exposure: Asset exposure refers to the greatest possible loss to the insurance company from the value of assets underlying general or separate account contracts falling to zero.

c. Benchmark: Benchmarks have similar risk characteristics to the entity (e.g., asset class, index or fund) to be modeled.

d. Deterministic Calculations: In a deterministic calculation, a given event (e.g., asset returns going up by 7% and then down by 5%) is assumed to occur with certainty. In a stochastic calculation, events are assigned probabilities.

e. Foreign Securities: These are securities issued by entities outside the U.S.

f. Grouped Fund Holdings: Grouped fund holdings relate to guarantees that apply across multiple deposits or for an entire contract instead of on a deposit-by-deposit basis.

g. Guaranteed Value: The guaranteed value is the benefit base or a substitute for the account value (if greater than the account value) in the calculation of living benefits or death benefits. The methodology for setting the guaranteed value is defined in the variable annuity contract.

h. High-Yield Bonds: High-yield bonds are below investment grade, with NAIC ratings (if assigned) of 3, 4, 5 or 6. Compared to investment grade bonds, these bonds have higher risk of loss due to credit events. Funds predominately containing securities that are not NAIC rated as 1 or 2 (or similar agency ratings) are considered to be high-yield.

i. Investment Grade Fixed Income Securities: Securities with NAIC ratings of 1 or 2 are investment grade. Funds containing securities predominately with NAIC ratings of 1 or 2 or with similar agency ratings are considered to be investment grade.

j. Liquid Securities: These securities can be sold and converted into cash at a price close to its true value in a short period of time.

k. Margin Offset: Margin offset is the portion of charges plus any revenue-sharing allowed under Section 4.A.5 available to fund claims and amortization of the unamortized surrender charges allowance.

l. Multi-Point Linear Interpolation: This methodology is documented in mathematical literature and calculates factors based on multiple attributes categorized with discrete values where the attributes’ actual values may be between the discrete values.

m. Model Office: A model office converts many contracts with similar features into one contract with specific features for modeling purposes.

n. Prepackaged Scenarios: Prepackaged scenarios are the year-by-year asset returns that may be used (but are not mandated) in projections related to the alternative methodology. These scenarios are available on the Academy website.

o. Quota-Share Reinsurance: In this type of reinsurance treaty, the same proportion is ceded on all cessions. The reinsurer assumes a set percentage of risk for the same percentage of the premium, minus an allowance for the ceding company’s expenses.

p. Resets: A reset benefit results in a future minimum guaranteed benefit being set equal to the contract’s account value at previous set date(s) after contract inception.

q. Risk Mitigation Strategy: A risk mitigation strategy is a device to reduce the probability and/or impact of a risk below an acceptable threshold.

r. Risk Profile: Risk profile in these requirements relates to the prescribed asset class categorized by the volatility of returns associated with that class.

s. Risk Transfer Arrangements: A risk transfer arrangement shifts risk exposures (e.g., the responsibility to pay at least a portion of future contingent claims) away from the original insurer.

t. Roll-Up: A roll-up benefit results in the guaranteed value associated with a minimum contractual guarantee increasing at a contractually defined interest rate.

u. Volatility: Volatility refers to the annualized standard deviation of asset returns.

3. Contract-by-Contract Application for Contracts That Contain No Guaranteed Living or Death Benefits

The Alternative Methodology reserve for each contract that contains no guaranteed living or death benefits shall be determined by applying VM-C-33. The application shall assume a return on separate account assets equal to the valuation interest rate for a non-variable annuity with similar features issued during the first calendar quarter of the same calendar year less appropriate asset based charges. It also shall assume a return for any fixed separate account and general account options equal to the rates guaranteed under the contract.

The reserve for such contracts shall be included in the aggregate minimum comparison defined in Section 7.A.1.b.

4. Contract-by-Contract Application for Contracts That Contain GMDBs Only

For each contract, factors are used to determine a dollar amount, equal to

*R* x (*CA + FE)* + GC (as described below), that is to be added to that contract’s cash surrender value as of the valuation date. The dollar amount to be added for any given contract may be negative, zero or positive. The factors that are applied to each contract shall reflect the following attributes as of the valuation date.

a. The contractual features of the variable annuity product.

b. The actual issue age, period since issue, attained age, years-to-maturity and gender applicable to the contract.

c. The account value and composition by type of underlying variable or fixed fund.

d. Any surrender charges.

e. The GMDB and the type of adjustment made to the GMDB for partial withdrawals (e.g., proportional or dollar-for-dollar adjustment).

f. Expenses to be incurred and revenues to be received by the company as estimated on a prudent estimate basis as described in Section 4.A.1. and complying with the requirements for revenue sharing as described in Section 4.A.5.

5. Factor Components

Factors shall be applied to determine each of the following components.

**Guidance Note:** Material to assist in the calculation of the components is available on the Academy website at [*www.actuary.org/life/phase2.asp*](http://www.actuary.org/life/phase2.asp).

*CA* = Provision for amortization of the unamortized surrender charges calculated by the insurer based on each contract’s surrender charge schedule, using prescribed assumptions, except that lapse rates shall be based on the insurer’s prudent estimate, but with no provision for federal income taxes or mortality.

*FE* = Provision for fixed dollar expenses less fixed dollar revenue calculated using prescribed assumptions, the contract’s actual expense charges, the insurer’s anticipated actual expenses and lapse rates, both estimated on a prudent estimate basis, and with no provision for federal income taxes or mortality.

*GC =* Provision for the costs of providing the GMDB less net available spread-based charges determined by the formula *F×GV-G×AV×R,* where GV and AV are as defined in Section 6.C.1.

*R =* A scaling factor that is a linear function of the ratio of the margin offset to total account charges (*W*) and takes the form . The intercept and slope factors for this linear function may vary according to:

* Product type.
* Pro-rata or dollar-for-dollar reductions in guaranteed value following partial withdrawals.
* Fund class.
* Attained age.
* Contract duration.
* Asset-based charges.
* 90% of the ratio of account value to guaranteed value, determined in the aggregate for all contracts sharing the same product characteristics.

Tables of factors for *F, G, β1* and *β2* values reflecting a 65% confidence interval and ignoring federal income tax are available from the NAIC. In calculating directly from the linear function provided above, the margin ratio *W* must be constrained to values greater than or equal to 0.2 and less than or equal to 0.6.

Interpolated values of *F*, *G* and *R* (calculated using the linear function described above) for all contracts having the same product characteristics and asset class shall be derived from the pre-calculated values using multi-point linear interpolation over the following four contract-level attributes:

* 1. Attained age.
	2. Contract duration.
	3. Ratio of account value to GMDB.

d. The total of all asset-based charges, including any fund management fees or allowances based on the underlying variable annuity funds received by the insurer.

The gross asset-based charges for a product shall equal the sum of all contractual asset-based charges plus fund management fees or allowances based on the underlying variable annuity funds received by the insurer determined by complying with the requirements for prudent estimate described in Section 1.E.2.i and revenue sharing described in Section 3.A.5. Net asset-based charges equal gross asset-based charges less any company expenses assumed to be incurred expressed as a percentage of account value. All expenses that would be assumed if a stochastic reserve were being computed as described in Section 4.A.1 should be reflected either in the calculation of the net asset based charges or in the expenses reflected in the calculation of the amount *FE*.

No adjustment is made for federal income taxes in any of the components listed above.

For purposes of determining the reserve using the Alternative Methodology, any interpretation and application of the requirements of these requirements shall follow the principles discussed in Section 1.B.

B. Calculation of *CA* and *FE*

1. General Description

Components *CA* and *FE* shall be calculated for each contract, thus reflecting the actual account value and GMDB, as of the valuation date, which is unique to each contract.

Components *CA* and *FE* are defined by deterministic “single-scenario” calculations that account for asset growth, interest and inflation at prescribed rates. Mortality is ignored for these two components. Lapse rates shall be determined on a prudent estimate basis as described in Section 1.E.2.i. Lapse rates shall be adjusted by the formula shown below (the dynamic lapse multiplier), which bases the relationship of the GMDB (denoted as GV in the formula) to the account value (denoted as AV in the formula) on the valuation date. Thus, projected lapse rates are smaller when the GMDB is greater than the account value and larger when the GMDB is less than the account value.

 , where *U*=1, *L*=0.5, *M*=1.25, and *D*=1.1.

Present values shall be computed over the period from the valuation date to contract maturity at a discount rate of 5.75%.

Projected fund performance underlying the account values is as shown in the table below. Unlike the *GC* component, which requires the entire account value to be mapped, using the fund categorization rules set forth in Section 6.D, to a single “equivalent” asset class (as described in Section 6.D.3), the *CA* and *FE* calculation separately projects each variable subaccount (as mapped to the eight prescribed categories shown in Section 6.D using the net asset returns shown in the following table). If surrender charges are based wholly on deposits or premiums as opposed to account value, use of this table may not be necessary.

|  |  |
| --- | --- |
| **Asset Class/Fund** | **Net Annualized Return** |
| Fixed Account | Guaranteed Rate |
| Money Market | 0% |
| Fixed Income (Bond) | 0% |
| Balanced | -1% |
| Diversified Equity | 2% |
| Diversified International Equity | 3% |
| Intermediate Risk Equity | 5% |
| Aggressive or Exotic Equity | 8% |

2. Component *CA*

Component *CA* is computed as the present value of the projected change in surrender charges plus the present value of an implied borrowing cost of 25 bps at the beginning of each future period applied to the surrender charge at such time.

This component can be interpreted as the “amount needed to amortize the unamortized surrender charge allowance for the *persisting* policies plus the implied borrowing cost.” By definition, the amortization for non-persisting lives in each time period is exactly offset by the collected surrender charge revenue (ignoring timing differences and any waiver upon death). The unamortized balance must be projected to the end of the surrender charge period using the net asset returns and Dynamic Lapse Multiplier, both as described above, and the year-by-year amortization discounted also as described above. For simplicity, mortality is ignored in the calculations. Surrender charges and free partial withdrawal provisions are as specified in the contract. Lapse and withdrawal rates are determined on a prudent estimate basis and may vary according to the attributes of the business being valued including, but not limited to, attained age, contract duration, etc.

1. Component *FE*

Component *FE* establishes a provision for fixed dollar expenses (e.g., allocated costs, including overhead expressed as “per contract” *and* those expenses defined on a “per contract” basis) less any fixed dollar revenue (e.g., annual administrative charges or contract fees) through the earlier of contract maturity or 30 years. *FE* is computed as the present value of the company’s assumed fixed expenses projected at an assumed annual rate of inflation starting in the second projection year. This rate grades uniformly from the current inflation rate (CIR) into an ultimate inflation rate of 3% per annum in the 8th year after the valuation date. The CIR is the greater of 3% and the inflation rate assumed for expenses in the company’s most recent asset adequacy analysis for similar business.

1. Calculation of the *GC* Component
2. *GC* Factors

*GC* is calculated as *F×GV-G×AV×R*, where *GV* is the amount of the GMDB and *AV* is the contract account value, both as of the valuation date. *F*, *G* and the slope and intercept for the linear function used to determine *R* (identified symbolically as β1 and β2) are pre-calculated factors available from the NAIC and known herein as the “pre-calculated factors.” The factors shall be interpolated as described in Section 6.C.6 and modified as necessary as described in Section 6.C.7 and Section 6.C.8.

1. Five Steps

There are five major steps in determining the *GC* component for a given contract:

a. Classifying the asset exposure, as specified in Section 6.C.3.

b. Determining the risk attributes, as specified in Section 6.C.4 and Section 6.C.5.

c. Retrieving the appropriate nodal factors from the factor grid, as described in Section 6.C.5.

d. Interpolating the nodal factors, where applicable (optional), as described in Section 6.C.6.

e. Applying the factors to the contract values.

3. Classifying Asset Exposure

For purposes of calculating *GC* (unlike what is done for components *CA* and *FE*), the entire account value for each contract must be assigned to one of the eight prescribed fund classes shown in Section 6.D, using the fund categorization rules in Section 6.D.

1. Product Designs

Factors *F, G* and are available with the pre-calculated factors for the following GMDB product designs:

a. Return of premium (ROP).

b. Premiums less withdrawals accumulated at 3% per annum, capped at 2.5 times premiums less withdrawals, with no further increase beyond age 80 (ROLL3).

c. Premiums less withdrawals accumulated at 5% per annum, capped at 2.5 times premiums less withdrawals, with no further increase beyond age 80 (ROLL5).

d. An annual ratchet design (maximum anniversary value), for which the guaranteed benefit never decreases and is increased to equal the previous contract anniversary account value, if larger, with no further increases beyond age 80 (MAV).

e. A design having a guaranteed benefit equal to the larger of the benefits in designs c and d, above (HIGH).

f. An enhanced death benefit (EDB) equal to 40% of the net earnings on the account (i.e., 40% of account value less total premiums paid plus withdrawals made), with this latter benefit capped at 40% of premiums less withdrawals.

5. Other Attributes

Factors *F*, *G* and are available within the pre-calculated factors for the following set of attributes:

a. Two partial withdrawal rules—one for contracts having a pro-rata reduction in the GMDB and another for contracts having a dollar-for-dollar reduction.

b. The eight asset classes described in Section 6.D.2.

c. Eight attained ages, with a five-year age setback for females.

d. Five contract durations.

e. Seven values of *GV*/*AV*.

f. Three levels of asset-based income.

6. Interpolation of *F, G* and

a. Apply to a contract having the product characteristics listed in Section 6.E.1 and shall be determined by selecting values for the appropriate partial withdrawal rule and asset class and then using multipoint linear interpolation among published values for the last four attributes shown in Section 6.C.5.

b. Interpolation over all four dimensions is not required, but if not performed over one or more dimensions, the factor used must result in a conservative (higher) value of *GC*. However, simple linear interpolation using the *AVGV* ratio is mandatory. In this case, the company must choose nodes for the other three dimensions according to the following rules: next highest attained age, nearest duration and nearest annualized account charge differential, as listed in Section 6.E.3 (i.e., capped at +100 and floored at –100 bps).

c. For , the interpolation should be performed on the scaling factors *R* calculated using β1, β2, using the ratio of margin offset to total asset charges (*W*), not on the factors β1 and β2 themselves.

d. An Excel workbook, Excel add-in and companion dynamic link library (.dll) program is available from the NAIC that can be used to determine the correct values and perform the multipoint linear interpolation.

e. Alternatively, published documentation can be referenced on performing multipoint linear interpolation and the required 16 values determined using a key that is documented in the table *Components of Key Used for GC Factor Look-Up* located in Section 6.E.3.

7. Adjustments to *GC* for Product Variations and Risk Mitigation/Transfer

In some cases, it may be necessary to make adjustments to the published factors due to:

a. A variation in product form wherein the definition of the guaranteed benefit is materially different from those for which factors are available. (See Section 6.C.8.)

b. A risk mitigation or other management strategy, other than a hedging strategy, that cannot be accommodated through a straightforward and direct adjustment to the published values.

Adjustments may not be made to *GC* for hedging strategies.

Any adjustments to the published factors must be fully documented and supported through stochastic analysis. Such analysis may require stochastic simulations, but would not ordinarily be based on full in-force projections. Instead, a representative “model office” should be sufficient. Use of these adjusted factors must be supported by a periodic review of the appropriateness of the assumptions and methods used to perform the adjustments, with changes made to the adjustments when deemed necessary by such review.

Note that minor variations in product design do not necessarily require additional effort. In some cases, it may be reasonable to use the factors/formulas for a different product form (e.g., for a roll-up GMDB near or beyond the maximum reset age or amount, the ROP GMDB factors/formulas shall be used, possibly adjusting the guaranteed value to reflect further resets, if any). In other cases, the reserves may be based on two different guarantee definitions and the results interpolated to obtain an appropriate value for the given contract/cell. Likewise, it may be possible to adjust the Alternative Methodology results for certain risk transfer arrangements without significant additional work (e.g., quota-share reinsurance without caps, floors or sliding scales would normally be reflected by a simple pro-rata adjustment to the “gross” *GC* results).

However, if the contract design is sufficiently different from those provided and/or the risk mitigation strategy is nonlinear in its impact on the reserve, and there is no practical or obvious way to obtain a good result from the prescribed factors/formulas, any adjustments or approximations must be supported using stochastic modeling. Notably this modeling need not be performed on the whole portfolio, but can be undertaken on an appropriate set of representative policies.

8. Adjusting *F* and *G* for Product Design Variations

This subsection describes the typical process for adjusting *F* and *G* factors due to a variation in product design. Note that *R* (as determined by the slope and intercept terms in the factor table) would not be adjusted.

a. Select a contract design among those described in Section 6.C.4 that is similar to the product being valued. Execute cash-flow projections using the documented assumptions (see table of *Liability Modeling Assumptions & Product Characteristics* in Section 6.E.1 and table of *Asset-Based Fund Charges* in Section 6.E.2) and the prepackaged scenarios for a set of representative cells (combinations of attained age, contract duration, asset class, AV/GMDB ratio and asset-based charges). These cells should correspond to nodes in the table of precalculated factors. Rank (order) the sample distribution of results for the present value of net cost. Determine those scenarios that comprise CTE (65).

**Guidance Note:** Present value of net cost = PV [guaranteed benefit claims in excess of account value] – PV [margin offset]. The discounting includes cash flows in all future years (i.e., to the earlier of contract maturity and the end of the horizon).

b. Using the results from step 1, average the present value of cost for the CTE (65) scenarios and divide by the current guaranteed value. For the *Jth* cell, denote this value by *FJ.* Similarly, average the present value of the margin offset revenue for the same subset of scenarios and divide by account value. For the *Jth* cell, denote this value by *GJ.*

c. Extract the corresponding precalculated factors. For each cell, calibrate to the published tables by defining a “model adjustment factor” (denoted by asterisk) separately for the “cost” and “margin offset” components:

 and

* 1. Execute “product specific” cash-flow projections using the documented assumptions and prepackaged scenarios for the same set of representative cells. Here, the company should model the actual product design. Rank (order) the sample distribution of results for the present value of net cost. Determine those scenarios that comprise CTE (65).
	2. Using the results from step d, average the present value of cost for the CTE (65) scenarios and divide by the current guaranteed value. For the *Jth* cell, denote this value by . Similarly, average the present value of margin offset revenue for the same subset of scenarios and divide by account value. For the *Jth* cell, denote this value by
	3. To calculate the reserve for the specific product in question, the company should implement the Alternative Methodology as documented, but use in place of *F* and instead of *G*. The same *R* factors as appropriate for the product evaluated in step 1 shall be used for this step (i.e., the product used to calibrate the cash-flow model).

9. Adjusting *GC* for Mortality Experience

The factors that have been developed for use in determining *GC* assume male mortality at 100% of the 1994 Variable Annuity MGDB ALB Mortality Table. Companies electing to use the Alternative Methodology that have not conducted an evaluation of their mortality experience shall use these factors. Other companies should use the procedure described below to adjust for the actuary’s prudent estimate of mortality. The development of prudent estimate mortality shall follow the requirements and guidance of Section 12. Once a company uses the modified method for a block of business, the option to use the unadjusted factors is no longer available for that part of its business. In applying the factors to actual in-force business, a five-year age setback should be used for female annuitants.

a. Develop a set of mortality assumptions based on prudent estimate. In setting these assumptions, the actuary shall be guided by the definition of prudent estimate and the principles discussed in Sections 10 and 11.

b. Calculate two sets of NSPs at each attained age: one valued using 100% of the 1994 Variable Annuity MGDB Age Last Birthday (ALB) Mortality Table (with the aforementioned five-year age setback for females) and the other using prudent estimate mortality. These calculations shall assume an interest rate of 3.75% and a lapse rate of 7% per year.

c. The *GC* factor is multiplied by the ratio, for the specific attained age being valued, of the NSP calculated using the prudent estimate mortality to the NSP calculated using the 1994 Variable Annuity MGDB ALB Mortality Table (with the aforementioned five-year age setback for females).

D. Fund Categorization

1. Criteria

The following criteria should be used to select the appropriate factors, parameters and formulas for the exposure represented by a specified guaranteed benefit. When available, the volatility of the long-term annualized total return for the fund(s)—or an appropriate benchmark—should conform to the limits presented. For this purpose, “long-term” is defined as twice the average projection period that would be applied to test the product in a stochastic model (generally, at least 30 years).

Where data for the fund or benchmark are too sparse or unreliable, the fund exposure should be moved to the next higher volatility class than otherwise indicated. In reviewing the asset classifications, care should be taken to reflect any additional volatility of returns added by the presence of currency risk, liquidity (bid – ask) effects, short selling and speculative positions.

2. Asset Classes

Variable subaccounts must be categorized into one of the following eight asset classes. For purposes of calculating *CA* or *FE*, each contract will have one or more of the following asset classes represented, whereas for component *GC*, all subaccounts will be mapped into a single asset class.

a. Fixed account: This class is credited interest at guaranteed rates for a specified term or according to a “portfolio rate” or “benchmark” index. This class offers a minimum positive guaranteed rate that is periodically adjusted according to company policy and market conditions.

b. Money market/short-term: This class is invested in money market instruments with an average remaining term-to-maturity of less than 365 days.

c. Fixed income: This class is invested primarily in investment grade fixed income securities. Up to 25% of the funds within this class may be invested in diversified equities or high-yield bonds. The expected volatility of the returns for this class will be lower than the balanced fund class.

d. Balanced: This class is a combination of fixed income securities with a larger equity component. The fixed income component should exceed 25% of the portfolio. Additionally, any aggressive or “exotic” equity component should not exceed one-third (33.3%) of the total equities held. Should the fund violate either of these constraints, it should be categorized as an equity fund. This class usually has a long-term volatility in the range of 8%–13%.

e. Diversified equity: This class is invested in a broad-based mix of U.S. and foreign equities. The foreign equity component (maximum 25% of total holdings) must be comprised of liquid securities in well-developed markets. Funds in this class would exhibit long-term volatility comparable to that of the S&P 500. These funds should usually have a long-term volatility in the range of 13%–18%.

f. Diversified international equity: This class is similar to the diversified equity class, except that the majority of fund holdings are in foreign securities. This class should usually have a long-term volatility in the range of 14%–19%.

g. Intermediate risk equity: This class has a mix of characteristics from both the diversified and aggressive equity classes. This class has a long-term volatility in the range of 19%–25%.

h. Aggressive or exotic equity: This class comprises more volatile funds where risk can arise from: underdeveloped markets, uncertain markets, high volatility of returns, narrow focus (e.g., specific market sector), etc. This class (or market benchmark) either does not have sufficient history to allow for the calculation of a long-term expected volatility, or the volatility is very high. This class would be used whenever the long-term expected annualized volatility is indeterminable or exceeds 25%.

3. Selecting Appropriate Investment Classes

The selection of an appropriate investment type should be done at the level for which the guarantee applies. For guarantees applying on a deposit-by-deposit basis, the fund selection is straightforward. However, where the guarantee applies across deposits or for an entire contract, the approach can be more complicated. In such instances, the approach is to identify for each contract where the “grouped holdings” fit within the categories listed and to classify the associated assets on this basis.

A seriatim process is used to identify the “grouped” fund holdings, to assess the risk profile of the current fund holdings (possibly calculating the expected long-term volatility of the funds held with reference to the indicated market proxies) and to classify the entire “asset exposure” into one of the specified choices. Here, “asset exposure” refers to the underlying assets (separate and/or general account investment options) on which the guarantee will be determined. For example, if the guarantee applies separately for each deposit year within the contract, then the classification process would be applied separately for the exposure of each deposit year.

In summary, mapping the benefit exposure (i.e., the asset exposure that applies to the calculation of the guaranteed minimum death benefits) to one of the prescribed asset classes is a multistep process:

1. Map each separate and/or general account investment option to one of the prescribed asset classes. For some funds, this mapping will be obvious, but for others, it will involve a review of the fund’s investment policy, performance benchmarks, composition and expected long-term volatility.
2. Combine the mapped exposure to determine the expected long-term “volatility of current fund holdings.” This will require a calculation based on the expected long-term volatility for each fund and the correlations between the prescribed asset classes as given in the table “*Correlation Matrix for Prescribed Asset Classes*” in Section 6.D.4.
3. Evaluate the asset composition and expected volatility (as calculated in step b) of current holdings to determine the single asset class that best represents the exposure, with due consideration to the constraints and guidelines presented earlier in this section.
4. In step a, the company should use the fund’s actual experience (i.e., historical performance, inclusive of reinvestment) only as a guide in determining the expected long-term volatility. Due to limited data and changes in investment objectives, style and/or management (e.g., fund mergers, revised investment policy, different fund managers, etc.), the company may need to give more weight to the expected long-term volatility of the fund’s benchmarks. In general, the company should exercise caution and not be overly optimistic in assuming that future returns will consistently be less volatile than the underlying markets.
5. In step b, the company should calculate the “volatility of current fund holdings” (for the exposure being categorized) by the following formula:



Using the volatilities and correlations in the following table where

 

is the relative value of fund i expressed as a proportion of total contract value,  is the correlation between asset classes i and j, and  is the volatility of asset class i. An example is provided after the table.

4. Correlation Matrix for Prescribed Asset Classes

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Annual Volatility |  | Fixed Account | Money Market | Fixed Income | Balanced | Diverse Equity | Intl Equity | Interm Equity | Aggr Equity |
| 1.0% | Fixed Account | **1** | 0.50 | 0.15 | 0 | 0 | 0 | 0 | 0 |
| 1.5% | Money Market | 0.50 | **1** | 0.20 | 0 | 0 | 0 | 0 | 0 |
| 5.0% | Fixed Income | 0.15 | 0.20 | **1** | 0.30 | 0.10 | 0.10 | 0.10 | 0.05 |
| 10.0% | Balanced | 0 | 0 | 0.30 | **1** | 0.95 | 0.60 | 0.75 | 0.60 |
| 15.5% | Diverse Equity | 0 | 0 | 0.10 | 0.95 | **1** | 0.60 | 0.80 | 0.70 |
| 17.5% | Intl Equity | 0 | 0 | 0.10 | 0.60 | 0.60 | **1** | 0.50 | 0.60 |
| 21.5% | Interm Equity | 0 | 0 | 0.10 | 0.75 | 0.80 | 0.50 | **1** | 0.70 |
| 26.0% | Aggr Equity | 0 | 0 | 0.05 | 0.60 | 0.70 | 0.60 | 0.70 | **1** |

5. Fund Categorization Example

As an example, suppose three funds (fixed income, diversified U.S. equity and aggressive equity) are offered to clients on a product with a contract level guarantee (i.e., across all funds held within the contract). The current fund holdings (in dollars) for five sample contracts are shown in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** |
| MV Fund X (Fixed Income) | 5,000 | 4,000 | 8,000 | - | 5,000 |
| MV Fund Y (Diversified Equity) | 9,000 | 7,000 | 2,000 | 5,000 | - |
| MV Fund Z (Aggressive Equity) | 1,000 | 4,000 | - | 5,000 | 5,000 |
| Total Market Value | 15,000 | 15,000 | 10,000 | 10,000 | 10,000 |
| Total Equity Market Value | 10,000 | 11,000 | 2,000 | 10,000 | 5,000 |
| Fixed Income % (*A*) | 33% | 27% | 80% | 0% | 50% |
| Fixed Income Test (*A* > 75%) | No | No | Yes | No | No |
| Aggressive % of Equity (B) | 10% | 36% | n/a | 50% | 100% |
| Balanced Test (*A* > 25% &*B* < 33.3%) | Yes | No | n/a | No | No |
| Volatility of Current Fund Holdings | 10.9% | 13.2% | 5.3% | 19.2% | 13.4% |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fund Classification | **Balanced** | **Diversified[[1]](#footnote-2)** | **Fixed Income** | **Intermediate** | **Diversified** |

As an example, the “volatility of current fund holdings” for contract #1 is calculated as where:



So, the volatility for contract #1 = = 0.109 or 10.9%

E. Tables

1. Liability Modeling Assumptions and Product Characteristics used for *GC* Factors

|  |  |
| --- | --- |
| Asset Based Charges(MER) | Vary by fund class. See Section 6.E.2. |
| Base Margin Offset | 100 bps per annum. |
| GMDB Description | 1. ROP = return of premium.2. ROLL3 = 3% roll-up, capped at 2.5×premium, frozen at age 80.3. ROLL5 = 5% roll-up, capped at 2.5×premium, frozen at age 80.4. MAV = annual ratchet (maximum anniversary value), frozen at age 80.5. HIGH = higher of 5% roll-up and annual ratchet.6. EDB = 40% enhanced death benefit (capped at 40% of deposit). Note that the pre-calculated factors were originally calculated with a combined ROP benefit, but they have been adjusted to remove the effect of the ROP. Thus, the factors for this benefit five are solely for the EDB. |
| Adjustment to GMDB Upon Partial Withdrawal | Separate factors for “pro-rata by market value” and “dollar-for-dollar.” |
| Surrender Charges | Ignored (i.e., zero). Included in the *CA* component. |
| Single Premium/Deposit | $100,000. No future deposits; no intra-contract fund rebalancing. |
| Base Contract Lapse Rate(Total Surrenders) | Pro-rata by MV: 10% p.a. at all contact durations (before dynamics). Dollar-for-dollar: 2% p.a. at all contract durations (no dynamics). |
| Partial Withdrawals | Pro-rata by MV: None (i.e., zero).Dollar-for-dollar: Flat 8% p.a. at all contract durations (as a % of AV). No dynamics or anti-selective behavior. |
| Mortality | 100% of the 1994 Variable Annuity MGDB Mortality Table (MGDB 94 ALB). For reference, 1000*qx* rates at ages 65 and 70 for 100% of MGDB 94 ALB Male are 18.191 and 29.363, respectively. **Note**: Section 6.C.9 allows modification to this assumption. |
| Gender/Age Distribution | 100% male. Methodology accommodates different attained ages. A five-year age setback will be used for female annuitants. |
| Max. Annuitization Age | All policies terminate at age 95. |
| Fixed Expenses | Ignored (i.e., zero). Included in the *FE* component. |
| Annual Fee and Waiver | Ignored (i.e., zero). Included in the *FE* component. |
| Discount Rate | 5.75% pre-tax. |
| Dynamic Lapse Multiplier (Applies only to policies where GMDB is adjusted “pro-rata by MV” upon withdrawal) | *U* = 1, *L* = 0.5, *M* = 1.25, *D* = 1.1 Applied to the “Base Contract Lapse Rate.” Does not apply to partial withdrawals. |

2. Asset-Based Fund Charges (bps per annum)

|  |  |
| --- | --- |
| **Asset Class/Fund** | **Account Value Charge** |
| Fixed Account | 0 |
| Money Market | 110 |
| Fixed Income (Bond) | 200 |
| Balanced | 250 |
| Diversified Equity | 250 |
| Diversified International Equity | 250 |
| Intermediate Risk Equity | 265 |
| Aggressive or Exotic Equity | 275 |

3. Components of Key Used for *GC* Factor Look-Up

**(First Digit always “1”)**

|  |  |
| --- | --- |
| Contract Attribute | Key: Possible Values and Description |
| Product Definition, P | 0 : 0 Return-of-premium.1 : 1 Roll-up (3% per annum).2 : 2 Roll-up (5% per annum).3 : 3 Maximum anniversary value (MAV).4 : 4 High of MAV and 5% roll-up.5 : 5 Enhanced death benefit (excludes the ROP GMDB, which would have to be added separately if the contract in question has an ROP).  |
| GV Adjustment Upon PartialWithdrawal, A | 0 : 0 Pro-rata by market value.1 : 1 Dollar-for-dollar. |
| Fund Class, F | 0 : 0 Fixed Account.1 : 1 Money Market.2 : 2 Fixed Income (Bond).3 : 3 Balanced Asset Allocation.4 : 4 Diversified Equity.5 : 5 International Equity.6 : 6 Intermediate Risk Equity.7 : 7 Aggressive/Exotic Equity. |
| Attained Age (Last Birthday), X | 0 : 35 4 : 651 : 45 5 : 702 : 55 6 : 753 : 60 7 : 80 |
| Contract Duration (years-since-issue),D | 0 : 0.5 1 : 3.52 : 6.5 3 : 9.54 : 12.5 |
| Account Value-to-Guaranteed ValueRatio, φ | 0 : 0.25 4 : 1.251 : 0.50 5 : 1.502 : 0.75 6 : 2.003 : 1.00 |
| Annualized Account ChargeDifferential from Section 6.E.2 Assumptions | 0 : −100 bps1 : +02 : +100 |

1. Although the volatility suggests “balanced fund,” the balanced fund criteria were not met. Therefore, this “exposure” is moved “up” to diversified equity. For those funds classified as diversified equity, additional analysis would be required to assess whether they should be instead designated as “diversified international equity.” [↑](#footnote-ref-2)