

SOCIETY OF ACTUARIES

Report on 2014
VBT/2017 CSO
Impact Study
Considerations for Life
Insurance Products



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Report on 2014 VBT/2017 CSO Impact Study

Considerations for Life Insurance Products

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In performing this analysis, we relied on data and other information submitted by companies participating in this research. Those companies are not named in this report in order to preserve confidentiality. The data we relied on includes the tabular data and aggregate data described in the Methodology section of this report and any verbal explanations around that data. We have not audited this data and other information. If the underlying data and information are inaccurate or incomplete, the results of our analysis may likewise be inaccurate or incomplete. We performed a limited review of the data used in this analysis for reasonableness and consistency and have not found material defects in the data. If there are material defects in the data, it is possible they would be uncovered by a detailed, systematic review. Such a review was beyond the scope of our assignment.

Executive Summary

The SOA engaged Milliman to develop an analysis using data submitted by participating companies evaluating the impact on reserves of valuation mortality tables proposed for use in the life insurance industry. The tables under study include beta versions of the 2014 Valuation Basic Table (2014 VBT), the 2014 Relative Risk tables and corresponding beta version of the 2017 Commissioners Standard Ordinary (2017 CSO) table. The 2017 CSO was developed by improving the 2014 VBT to 2017 and adding margin appropriate for valuation purposes. The version of the 2017 CSO without margins was also made available for this analysis. It is important to remember these tables are beta versions. Final versions may be different from tables tested in this analysis.

The analysis includes tests performed using tabular reserve data (i.e., reserves per unit) and aggregate data. The tabular data served to fulfill four primary objectives including: (i) overall impact on reserves, (ii) aggregation analysis, (iii) ultimate-to-select-and-ultimate (S&U) analysis, and (iv) margin analysis. The aggregate data served to facilitate comparison of formulaic reserves to VM-20 modeled deterministic reserves (DRs).

In the analysis demonstrating the overall impact of moving from the 2001 CSO valuation table to the 2017 CSO valuation table, findings regarding the degree of reduction in reserve levels vary by product type and by the risk class structure of the valuation table. Unless noted otherwise, the basis used is the ultimate basis. Whole life (WL) product reserves are reduced from 6 percent to 10 percent in duration 5, grading off as the policy duration increases to maturity. Universal life with secondary guarantee (ULSG) reserves are reduced 5 percent to 11 percent in duration 5 also grading off as the policy ages, though more slowly than for WL. Mean reserves for the 20-year level premium term product (Term) are reduced across all durations of the level premium period, with the amount of reduction varying by the risk class structure of the table. The 5-class system shows reserve reductions ranging from 36 to 40 percent on an ultimate basis; 31 to 33 percent on an S&U basis. The 2-class system shows reserve reductions ranging from 40 to 46 percent. The 1-class system shows reserve reductions ranging from 29 to 35 percent.

Characteristics of the reduction in reserve levels are largely consistent between product types and include:

- A greater reduction is attributable to male risks than to female risks;
- A greater reduction is attributable to non-tobacco risks than to tobacco risks;
- Within the 5-class structure, a greater reduction is evident in the residual class than in the preferred classes. This may be due to underlying mortality changes as well as the method used to split the classes; and
- Reduction is more often seen in test issue ages 25, 35 and 45 than in test issue ages 55, 65 and 75, though this can vary by table structure.

While the data call sent to participating companies included accumulation universal life products, no data was submitted for this product type. As it relates to this analysis, accumulation universal life may be considered to exhibit characteristics similar to WL.

In testing whether reserves from the more granular class structures aggregate to the less granular structures, the research finds only variances of up to 1 percent in the WL product, up to 3 percent in the ULSG product, and up to 5 percent in the Term product tested. The analysis is performed by duration, with test issue ages and genders combined. This test weights reserves from the 5-class structure according to the distribution of face amount from the underlying mortality study data, aggregates by tobacco class, and compares the outcome to calculated reserves from participating companies on each class of the 2-class structure. A similar test is performed from the 2-class

structure to the 1-class structure. The small variances in the testing outcome indicate that the integrity of the method used to produce the mortality table splits by risk class carries through to the calculated reserves used in the analysis.

Similar to the 2001 CSO tables, testing of the 2017 CSO tables shows that reserves using the ultimate valuation mortality tables provide lower reserves at most durations when compared to reserves using the S&U valuation mortality tables. This is clearly evident in the WL product, and to a lesser degree, in the ULSG product. It is also demonstrated in the Term product with the exception of the 20th policy year. By the 20th policy year in the Term product, the mean reserve is dependent upon only the valuation net premium.

The margin analysis portion of this research indicates that relative margin has increased for reserves calculated using the 2017 CSO tables as compared to reserves calculated using the 2001 CSO tables. For the WL product, the relative margin has increased from 1 percent to 4 percent depending on valuation table structure. For the Term product, the overall relative margin has increased from 1 percent to 14 percent during the level premium period depending on valuation table structure. For the ULSG product, the overall margin has increased from 3 percent to 4 percent depending on valuation table structure. The increase in margin between the three risk class structures (5-class, 2-class and 1-class) is similar. However, when viewed by risk class or test issue age within each table, the results suggest shifts in margin. By tobacco class, the margin appears to have shifted from the nonsmoker and into the smoker class. By risk class, the margin appears to have shifted from the residual nonsmoker class and into the preferred nonsmoker classes. By test issue age, the margin appears to have shifted from the younger test issue ages to older test issue ages, where the outcome by test issue age varies by product type. For the ULSG product, these trends may not be as clear, due to the adjustments a company had to make to its nonguaranteed element structure (guaranteed and potentially current) upon adopting the proposed 2017 CSO tables as the basis for the guaranteed cost of insurance charge structure.

Auxiliary cash value information specific to 30-year level premium term products indicates that cash values will not develop under the proposed 2017 CSO tables when cash values are calculated consistent with the Standard Nonforfeiture Law for Life Insurance and when post-level premium period premiums are recalibrated to the 2017 CSO mortality rates.

The aggregate data provided by participating companies included formulaic reserves based on VM-20 net premium reserve (NPR) methods for Term and ULSG, and based on current statutory methods (CRVM) for WL; as well as modeled VM-20 DR for a one-year cohort of business. The majority of data submitted is for Term and ULSG. The outcomes for the Term product demonstrate the following characteristics:

- The 2017 CSO table provides a markedly lower NPR pattern (NPR (2017)) as compared to an NPR pattern under the 2001 CSO (NPR (2001)).
- Most companies show an NPR (2001) in excess of DR by the middle of the level premium period, while the NPR (2017) is equal to or less than the DR during the level premium period.
- Even for companies with fully credible mortality experience, the majority of Term products submitted as part of this analysis demonstrate a DR in excess of the NPR (2017).

- For a company with the highest levels of credibility, the Bühlmann credibility method and margins appear to produce a DR level that is slightly less than a similar DR using the limited-fluctuation credibility method and margins.
- In submissions where the company tested the DR on both the 2008 VBT and the 2014 VBT, DR (2014) produced a reserve pattern in excess of DR (2008) in some durations, lower in others. Reasons for this relationship may stem from the process used to recalibrate the company's expected basis in its mortality study. For example, an actual-to-expected ratio using the 2014 VBT as "expected" would produce a higher ratio than would otherwise emerge if using the 2008 VBT as "expected." If this condition occurs for portions of the modeled population with the greatest amount of in-force, it may have a greater impact than one would expect, particularly if the actual-to-expected ratio does not vary by duration. Or, if the company did not recalibrate its mapping to the 2014 VBT Relative Risk tables using the updated Underwriting Criteria Scoring (UCS) tool, and simply used the mapping derived from an older UCS, this too could skew the results in an unexpected way.

The outcomes for ULSG share these characteristics.

- The NPR (2017) is marginally lower than NPR (2001).
- Both NPR (2001) and NPR (2017) are less than DR at most policy durations.
- For a company with the highest levels of credibility, the Bühlmann credibility method and margins appear to produce a DR level that is slightly less than a similar DR using the limited-fluctuation credibility method and margins.

Background and Scope

The SOA made available the 2014 Valuation Basic Table (2014 VBT), the 2017 Commissioners Standard Ordinary table (2017 CSO), the 2017 CSO tables without margins, the 2014 Relative Risk VBT tables, mortality improvement factors appropriate for the subject tables, mortality margins consistent with limited-fluctuation credibility method, mortality margins consistent with Bühlmann credibility method, and an updated Underwriting Criteria Scoring (UCS) tool. All mortality tables, VM-20 mortality margins and rates of mortality improvement were made available in beta form for testing. Companies were recruited to implement and test these tables across a broad spectrum of table structures: unismoke, smoking distinct and preferred structure on ultimate and select and ultimate (S&U) bases. A data call was issued encouraging participation using the company product that best fit the descriptions found in the Products Tested section below.

Data items requested include:

- Tabular valuation net premiums and terminal reserves under the current Commissioner's Reserve Valuation Method (CRVM¹) or the formulaic component of VM-20 (net premium reserve (NPR)) methodology, depending on product type;
- Auxiliary information for cash value development under a 30-year-level-premium-term-to-95 product;
- Modeled amounts in aggregate for a one-issue-year cohort of business including the formulaic reserve (NPR or CRVM) and the VM-20 deterministic reserve (DR); and
- Supporting information relevant to the submission, including specific product design features, new business distributions, gross premiums, etc.

The number of companies participating by product type is summarized below.

For purposes of this report, the preferred structure tables are referred to as "5-class"; the smoking distinct tables are referred to as "2-class"; and the unismoke tables are referred to as "1-class."

Term insurance: 8 companies

- Tabular submissions on 5-class structure: 6
- Tabular submissions on 2-class structure: 3
- Tabular submissions on 1-class structure: 4

Whole life (WL) insurance: 4 companies

- Tabular submissions on 5-class structure: 2
- Tabular submissions on 2-class structure: 3
- Tabular submissions on 1-class structure: 4

Universal life with secondary guarantee (ULSG): 1 company

- Tabular submissions on 5-class structure: 1
- Tabular submissions on 2-class structure: 1
- Tabular submissions on 1-class structure: 1

¹ For WL, this is the one-year full preliminary term method, i.e., the current statutory methodology.

Beta Tables Tested

This analysis includes all table structures under consideration in the 2017 CSO beta collection: preferred structure (5-class), smoking distinct structure (2-class) and unismoke structure (1-class). Sections of the analysis that quantify the change from current tables to the proposed 2017 tables also involve calculating the reserve amounts under comparable 2001 CSO or 2001 VBT mortality tables.

In determining the overall impact of moving to the proposed 2017 CSO valuation tables, the study compared VM-20 NPRs or current CRVM reserves calculated on the 5-class, 2-class and 1-class versions of the tables listed below and compared these reserves to reserves calculated on comparable versions of the 2001 CSO mortality tables.

- 2017 CSO (ANB and ALB) Ultimate—beta version
- 2017 CSO (ANB and ALB) S&U—beta version

In assessing the more granular risk class splits compared to the less granular splits, the study employed the 5-class, 2-class and 1-class versions of the tables listed below.

- 2017 CSO (ANB and ALB) Ultimate—beta version
- 2017 CSO (ANB and ALB) S&U—beta version

In the comparison of reserves using ultimate basis as compared to the S&U basis, the study employed the 5-class, 2-class and 1-class versions of these tables:

- 2017 CSO (ANB and ALB) Ultimate—beta version
- 2017 CSO (ANB and ALB) S&U—beta version.

In measuring the margin implicit in the beta version of the 2017 CSO tables as compared to margin implicit in the 2001 CSO tables, the study employed the 5-class, 2-class and 1-class versions of the tables listed below and compared this result with comparable 2001 CSO and 2001 VBT tables.

- 2017 CSO (ANB and ALB) Ultimate—beta version
- 2017 CSO Unloaded (ANB and ALB) Ultimate—beta version
- 2017 CSO (ANB and ALB) S&U—beta version
- 2017 CSO Unloaded (ANB and ALB) S&U—beta version

For the aggregate analysis, the tables used as the basis for industry mortality include:

- 2014 VBT (ANB and ALB) Ultimate—beta version
- 2014 VBT (ANB and ALB) S&U—beta version
- 2014 VBT RR (ANB and ALB)—beta.

Two sets of proposed margin tables were also available for testing.

- Proposed limited-fluctuation margins
- Proposed Bühlmann margins

Products Tested

While each participating company was using its own product, the companies were asked to choose the product best fitting the description provided below. This guidance was provided in order to collect data as consistent as possible amongst the participating companies. All products are single life products (i.e., not joint life). Where applicable, any dividends are assumed to be paid in cash. As noted in the Executive Summary section above, there were no submissions received for accumulation universal life.

Whole life	Level benefit, level premium, permanent insurance. The preferred insurance period is to attained age 121 (“A121”); however, maturity prior to A121 is allowed. Premium-paying period consistent with the benefit period. No rider benefits.
Term insurance	Twenty-year level premium term followed by annually increasing premiums to age N. Insurance period to age N. Post-level term premiums increasing according to the slope of the underlying valuation mortality table. No rider benefits. No return of premium provisions. [All companies that provided term insurance data used products that guaranteed premiums for 20 years.] In addition to 20-year level premium periods, a 30-year level premium period is useful for analysis around minimum cash values on the proposed mortality tables.
Universal life	Level permanent insurance. The preferred insurance period is to A121; however, maturity prior to A121 but representing a full lifetime period is allowed. Premium-paying period consistent with the benefit period. No rider benefits.
ULSG	Level permanent insurance. The preferred insurance period is to A121; however, maturity prior to A121 but representing a full lifetime period is allowed. Premium-paying period consistent with the benefit period. The longest secondary guarantee provision should provide continuation of coverage to advanced age N where N may be less than the maturity age on the basic guarantee of the contract. A product with more than one secondary guarantee period is allowed—for example, a term ULSG product. If the secondary guarantee provision is attached as a rider, then include this rider benefit and value it as part of the base policy; otherwise, do not include rider benefits.

Methodology

Tabular Analysis

The methodology for the WL and Term tabular analysis was to collect valuation net premiums and terminal reserves per \$1,000 of insurance amount for sample issue ages 25 to 75 for all policy durations from issue to maturity. Mean reserves (${}_tMV_x$) were calculated from this data according to the formula below.

$${}_tMV_x = .50*({}_{t-1}V_x + {}_tP_x) + .50({}_tV_x)$$

In this formula, ${}_tV_x$ is the terminal reserve for issue age x , duration t , and ${}_tP_x$ is the valuation net premium for issue age x at duration t . Nearly all companies used an annual premium timing assumption and an immediate payment of claims assumption in calculating these actuarial amounts.

The methodology for the ULSG tabular analysis used an actual net reserve liability, ${}_tV_x$, rather than a mean reserve.

By product, the methodology for calculating reserves regardless of valuation table was as listed below.

Whole life product	Current statutory valuation method
20-year term product	VM-20 Section 3 NPR method
ULSG	VM-20 Section 3 NPR method

For each tested table, the mean reserves determined above were aggregated across various characteristic groupings (e.g., gender, tobacco-class, issue age, risk class) according to the industry model office definition based on face amounts of insurance and sourced from LIMRA data. This method of aggregating according to model office percentages was used for all policy years in the analysis.

The aggregated values of reserves were then averaged over the number of company contributors to that particular table structure. For example, the overall impact analysis uses the ratio of the 2017 CSO reserve divided by the 2001 CSO reserve, where the numerator and denominator are based on consistent structures, e.g., 5-class, ultimate. If there were four companies contributing to the particular product type and table type, then the aggregated reserve from all four companies is averaged before being used in the ratio. The number of companies contributing to each analysis table is noted in the table header.

The industry model office is sourced from LIMRA industry sales data by product, age, gender and rating class for 2012 and 2013. The definition of the model office is provided in Appendix A.

Aggregate Analysis

The methodology for analysis on an aggregate basis was to only look at the submissions company by company, since the modeled DR component is influenced by a company's assumptions and the distribution of business. Each company submission is portrayed graphically in the Aggregate Analysis sections.

Qualification for the Use of the Preferred Structure Mortality Tables

This research assumed, without demonstration, that the companies submitting data using the 5-class preferred structure mortality tables would qualify for their use had the demonstration been performed in compliance with Model Regulation 815.

Whole Life Product

The analysis presented for the WL product uses reserves calculated based on the methodology currently prescribed for WL, i.e., one-year full preliminary term. This method is also referred to in this report as “CRVM” or “current statutory valuation method.” The analysis compares reserves on the CRVM method using a mean reserve.

The overall impact analysis (Tables 1A, 1B and 1C) of moving from the 2001 CSO valuation table to the 2017 CSO valuation table demonstrates 6 to 10 percent reduction in duration 5 mean reserves, depending on the structure of the table used. This reduction grades off as the policy duration increases to maturity. Below is a summary of the comparison at the highest level of model office aggregation.

2017 CSO Mean Reserve as Percent of 2001 CSO Mean Reserve							
Overall							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Ultimate	92%	93%	94%	95%	97%	98%	99%
2-Class Ultimate	90%	92%	93%	94%	96%	98%	99%
1-Class Ultimate	94%	95%	96%	97%	98%	99%	100%

The following characteristics of the research outcomes are consistent between the 5-class, 2-class and 1-class structure tables.

- A greater reduction is attributed to male risks than to female risks.
- A greater reduction is attributed to non-tobacco risks than to tobacco risks.
- Within the 5-class structure, more reduction is evident in the residual class than in the preferred classes.
- Test issue ages 25, 35 and 45 demonstrate more reduction than do test issue ages 55, 65 and 75.
- Slight reserve increases are found at test issue age 75 and later durations of test issue ages 45, 55 and 65. This characteristic is consistent with the slope of the 2017 CSO at higher attained ages being steeper than the slope of the 2001 CSO at those attained ages.
- Reserve reductions shown for issue age 65 duration 50 and issue age 75 duration 40 are anomalies stemming from the flatness of the 2017 CSO mortality rates at the highest attained ages, where the 2001 CSO mortality rates are graded at these attained ages.

In the aggregation analysis (Table 2A—Ultimate basis and Table 2B—S&U basis) the calculated reserves from each of the five risk classes under the preferred structure tables, when weighted by the distribution of face amount from the underlying mortality study data and summed by tobacco class, reproduce to within 1 percent the calculated reserves from each of the risk classes under the 2-class structure. Similarly, the 2-class structure, when weighted by the distribution of face amount from the underlying mortality study data and summed, reproduces to within 1 percent the calculated reserves on the 1-class structure. See the shaded cells in Tables 2A and 2B for these validation ratios.

Ratios less than 100 percent in the ultimate-to-S&U analysis of Table 3 support the premise that reserves calculated using the ultimate table are less than reserves calculated using the S&U table.

The margin analysis indicates that relative margin has increased for reserves calculated using the 2017 CSO table as compared to reserves calculated using the 2001 CSO table (Table 4). When viewed by risk classes (Table 4A) or test issue ages (Table 4B) within each table structure, the results suggest shifts in margin.

For the 5-class structure:

- Although WL is not typically valued using the 5-class structure for valuation, it is used here for insight into the risk class relationships. Residual nonsmoker shows the least amount of relative change in margin, while residual smoker carries the most.
- Test issue ages 45, 55, 65 and 75 carry relatively more of the margin increase than test issue ages 25 and 35.

For the 2-class structure:

- Smoker risks carry relatively more of the margin increase than nonsmoker risks.
- Test issue ages 45, 55, 65 and 75 carry relatively more of the margin increase than test issue ages 25 and 35.

For the 1-class structure:

- Test issue ages 45, 55, 65 and 75 carry relatively more of the margin increase than test issue ages 25 and 35.

Whole Life Analysis—Overall Impact

Table 1A							
Comparison of CRVM Mean Reserves							
2017 CSO Ultimate Mean Reserve as a Percent of 2001 CSO Ultimate Mean Reserve							
Preferred Structure Table (5-Class)							
Average of Results from All Companies (2)							
Whole Life Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
Overall	92%	93%	94%	95%	97%	98%	99%
Gender							
Male	89%	91%	92%	93%	95%	97%	98%
Female	94%	95%	96%	97%	98%	99%	100%
Risk Class							
Super Preferred NS	94%	95%	96%	96%	98%	99%	99%
Preferred NS	93%	94%	95%	96%	97%	98%	99%
Residual NS	89%	91%	93%	94%	96%	98%	99%
Preferred S	99%	100%	100%	100%	100%	100%	100%
Residual S	94%	96%	97%	97%	98%	99%	100%
Tobacco Class							
Nonsmoker (NS)	91%	93%	94%	95%	97%	98%	99%
Smoker (S)	96%	97%	98%	98%	99%	100%	100%
Issue Age							
25	89%	90%	88%	88%	89%	92%	96%
35	86%	86%	87%	88%	92%	96%	99%
45	87%	89%	90%	93%	96%	100%	101%
55	91%	94%	96%	98%	101%	101%	100%
65	96%	99%	100%	102%	102%	100%	98%
75	100%	104%	105%	103%	100%	98%	
	2017 CSO Reserve – 2001 CSO Reserve						
	in Dollars						
25	(2.94)	(7.03)	(13.06)	(20.23)	(32.03)	(34.79)	(25.50)
35	(5.78)	(13.98)	(21.45)	(27.86)	(32.24)	(23.84)	(5.93)
45	(7.73)	(16.26)	(22.18)	(24.29)	(18.49)	(2.03)	6.74
55	(7.83)	(12.59)	(13.38)	(10.75)	3.80	10.34	2.41
65	(4.88)	(3.94)	0.45	10.12	15.04	2.41	(16.76)
75	0.19	13.92	27.12	20.74	2.41	(16.76)	

Table 1B							
Comparison of CRVM Mean Reserves							
2017 CSO Ultimate Mean Reserve as a Percent of 2001 CSO Ultimate Mean Reserve							
Smoking Distinct Structure Table (2-Class)							
Average of Results from All Companies (3)							
Whole Life Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
Overall	90%	92%	93%	94%	96%	98%	99%
Gender							
Male	88%	89%	91%	92%	94%	96%	98%
Female	92%	94%	95%	96%	98%	99%	100%
Tobacco Class							
Nonsmoker	89%	91%	93%	94%	96%	98%	99%
Smoker	95%	96%	97%	98%	99%	99%	100%
Issue Age							
25	87%	87%	86%	86%	87%	91%	95%
35	84%	84%	85%	87%	90%	95%	99%
45	85%	87%	89%	91%	96%	100%	101%
55	89%	92%	95%	97%	101%	102%	101%
65	95%	98%	100%	102%	103%	101%	97%
75	100%	104%	106%	104%	102%	96%	
	2017 CSO Reserve - 2001 CSO Reserve						
	in Dollars						
25	(3.77)	(8.99)	(16.18)	(24.46)	(38.13)	(42.01)	(31.57)
35	(6.95)	(16.49)	(25.18)	(32.71)	(38.67)	(29.44)	(7.55)
45	(9.16)	(19.19)	(26.40)	(29.54)	(23.44)	(3.07)	9.20
55	(9.64)	(16.04)	(17.69)	(14.71)	3.67	14.14	6.78
65	(6.78)	(6.06)	(0.21)	11.65	21.11	9.45	(27.64)
75	0.36	17.02	33.53	30.35	13.52	(37.59)	

Table 1C							
Comparison of CRVM Mean Reserves							
2017 CSO Ultimate Mean Reserve as a Percent of 2001 CSO Ultimate Mean Reserve							
Unismoke Structure Table (1-Class)							
Average of Results from All Companies (4)							
Whole Life Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
Overall	94%	95%	96%	97%	98%	99%	100%
Gender							
Male	90%	91%	92%	93%	95%	97%	98%
Female	98%	99%	100%	100%	101%	101%	101%
Issue Age							
25	91%	91%	90%	90%	91%	94%	97%
35	88%	88%	89%	91%	94%	98%	100%
45	90%	91%	93%	95%	98%	101%	101%
55	95%	97%	98%	99%	101%	102%	101%
65	98%	100%	101%	102%	102%	101%	97%
75	101%	104%	105%	103%	101%	96%	
	2017 CSO Reserve - 2001 CSO Reserve in Dollars						
25	(2.49)	(6.09)	(11.15)	(17.38)	(26.23)	(24.83)	(16.04)
35	(4.87)	(12.04)	(18.23)	(22.68)	(22.45)	(14.33)	0.70
45	(6.48)	(12.74)	(15.44)	(15.35)	(9.37)	4.53	9.10
55	(4.64)	(6.39)	(5.51)	(3.13)	9.75	12.63	4.84
65	(2.23)	(0.34)	4.17	14.21	16.73	6.12	(26.03)
75	1.93	17.16	29.58	22.25	8.10	(34.19)	

Whole Life Analysis—Aggregation Analysis

Table 2A							
Risk Class Aggregation Analysis							
2017 CSO Ultimate							
Results from One Company Providing All Table Structures							
Whole Life Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Structure	A) Reserve Per Unit						
Super Preferred NS	58.21	136.34	220.27	308.74	491.29	660.42	789.33
Preferred NS	59.65	139.12	223.98	313.07	495.97	664.12	791.35
Residual NS	61.16	142.01	227.83	317.55	500.85	668.14	793.67
Preferred S	72.08	163.01	256.55	351.29	537.58	698.36	812.05
Residual S	74.00	166.31	260.68	355.75	541.53	700.69	812.69
	B) Table Development Weightings (SOA), Preferred Class Structure						
Super Preferred NS	40%	40%	40%	40%	40%	40%	40%
Preferred NS	27%	27%	27%	27%	27%	27%	27%
Residual NS	32%	32%	32%	32%	32%	32%	32%
Preferred S	64%	64%	64%	64%	64%	64%	64%
Residual S	36%	36%	36%	36%	36%	36%	36%
	C) Sum of (A * B) by Tobacco Class						
Nonsmoker (NS)	58.96	137.54	221.49	309.64	490.70	657.29	783.37
Smoker (S)	72.77	164.20	258.04	352.89	539.00	699.20	812.28
2-Class Structure	D) Reserve Per Unit						
Nonsmoker	59.81	139.44	224.42	313.59	496.55	664.61	791.64
Smoker	73.05	164.76	258.82	353.83	540.00	699.92	812.60
	E) Validation (C/D)						
Nonsmoker	99%	99%	99%	99%	99%	99%	99%
Smoker	100%	100%	100%	100%	100%	100%	100%
	F) Table Development Weightings (SOA), Smoking Class Structure						
Nonsmoker	73%	73%	73%	73%	73%	73%	73%
Smoker	27%	27%	27%	27%	27%	27%	27%
	G) Sum of (D * F)						
Unismoke	63.39	146.28	233.71	324.46	508.28	674.14	797.30
1-Class Structure	H) Reserve Per Unit						
Unismoke	63.63	146.72	234.49	325.52	509.88	675.85	798.46
	I) Validation (G/H)						
Unismoke	100%	100%	100%	100%	100%	100%	100%

Table 2B							
Risk Class Aggregation Analysis							
2017 CSO Select & Ultimate							
Results from One Company Providing All Table Structures							
Whole Life Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Structure	A) Reserve Per Unit						
Super Preferred NS	60.02	141.11	227.09	315.42	495.21	662.41	790.31
Preferred NS	61.81	144.56	231.58	320.44	500.27	666.29	792.42
Residual NS	63.80	148.28	236.32	325.64	505.64	670.61	794.91
Preferred S	76.88	170.29	264.80	358.38	541.44	700.19	812.95
Residual S	79.62	174.93	270.43	364.21	546.19	702.87	813.71
	B) Table Development Weightings (SOA), Preferred Class Structure						
Super Preferred NS	40%	40%	40%	40%	40%	40%	40%
Preferred NS	27%	27%	27%	27%	27%	27%	27%
Residual NS	32%	32%	32%	32%	32%	32%	32%
Preferred S	64%	64%	64%	64%	64%	64%	64%
Residual S	36%	36%	36%	36%	36%	36%	36%
	C) Sum of (A * B) by Tobacco Class						
Nonsmoker (NS)	61.11	142.93	228.99	316.89	494.96	659.46	784.45
Smoker (S)	77.87	171.96	266.83	360.48	543.15	701.16	813.22
2-Class Structure	D) Reserve Per Unit						
Nonsmoker	62.01	144.94	232.07	320.99	500.87	666.78	792.71
Smoker	78.14	172.43	267.38	361.13	543.90	701.69	813.44
	E) Validation (C/D)						
Nonsmoker	99%	99%	99%	99%	99%	99%	99%
Smoker	100%	100%	100%	100%	100%	100%	100%
	F) Table Development Weightings (SOA), Smoking Class Structure						
Nonsmoker	73%	73%	73%	73%	73%	73%	73%
Smoker	27%	27%	27%	27%	27%	27%	27%
	G) Sum of (D * F)						
Unismoke	66.37	152.36	241.61	331.83	512.48	676.21	798.30
1-Class Structure	H) Reserve Per Unit						
Unismoke	66.48	153.57	243.93	334.50	514.74	678.21	799.69
	I) Validation (G/H)						
Unismoke	100%	99%	99%	99%	100%	100%	100%

Whole Life Analysis—Ultimate-to-S&U Analysis

Table 3							
Comparison of CRVM Mean Reserves							
2017 CSO Ultimate Mean Reserve as a Percent of 2017 CSO Select & Ultimate Mean Reserve							
Average of Results from All Companies (2)*							
Whole Life Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Structure							
Super Preferred NS	97%	97%	97%	98%	99%	100%	100%
Preferred NS	97%	96%	97%	98%	99%	100%	100%
Residual NS	96%	96%	96%	98%	99%	100%	100%
Preferred S	94%	96%	97%	98%	99%	100%	100%
Residual S	93%	95%	96%	98%	99%	100%	100%
2-Class Structure							
Nonsmoker (NS)	97%	96%	97%	98%	99%	100%	100%
Smoker (S)	94%	96%	97%	98%	99%	100%	100%
1-Class Structure							
Unismoke	96%	96%	96%	97%	99%	100%	100%

* Three companies contributed to the 2-class structure.

Whole Life Analysis—Margin Analysis

Table 4							
Comparison of CRVM Mean Reserves With and Without Margin							
Average of Results from All Companies (2)*							
Whole Life Product							
5-Class Ultimate							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Overall	105%	105%	104%	104%	103%	102%	102%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Overall	104%	103%	103%	103%	102%	101%	101%
	Difference (2017 – 2001)						
Overall	2%	2%	1%	1%	1%	1%	1%
	Difference in Dollar Amount						
Overall	0.72	1.80	2.78	3.61	4.89	5.45	5.24
2-Class Ultimate							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Overall	105%	105%	104%	104%	103%	102%	102%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Overall	104%	103%	103%	103%	102%	102%	101%
	Difference (2017 – 2001)						
Overall	2%	2%	2%	1%	1%	1%	1%
	Difference in Dollar Amount						
Overall	0.73	1.82	2.83	3.70	5.13	5.83	5.65
1-Class Ultimate							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Overall	108%	107%	107%	106%	104%	103%	102%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Overall	104%	103%	103%	103%	102%	101%	101%
	Difference (2017 – 2001)						
Overall	4%	4%	4%	3%	2%	1%	1%
	Difference in Dollar Amount						
Overall	2.40	5.67	8.12	8.81	8.15	7.37	6.33

* Three companies contributed to the 2-class structure.

Table 4A							
Comparison of CRVM Mean Reserves With and Without Margin							
Average of Results from All Companies							
Whole Life Product							
5-Class Ultimate by Risk Class							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve based on 2017 CSO / Reserve based on 2017 CSO Without Margin						
Super Preferred NS	105%	105%	104%	104%	103%	102%	102%
Preferred NS	105%	105%	104%	104%	103%	102%	102%
Residual NS	105%	105%	104%	104%	103%	102%	102%
Preferred S	106%	105%	105%	104%	103%	102%	102%
Residual S	106%	106%	105%	104%	103%	102%	102%
	Reserve based on 2001 CSO / Reserve based on 2001 VBT						
Super Preferred NS	104%	103%	103%	103%	102%	101%	101%
Preferred NS	104%	103%	103%	103%	102%	101%	101%
Residual NS	106%	105%	104%	103%	102%	101%	101%
Preferred S	103%	103%	103%	102%	102%	101%	101%
Residual S	103%	103%	103%	102%	102%	101%	101%
	Difference (2017 - 2001)						
Super Preferred NS	1%	1%	1%	1%	1%	1%	1%
Preferred NS	1%	1%	1%	1%	1%	1%	1%
Residual NS	0%	0%	0%	1%	1%	1%	1%
Preferred S	3%	2%	2%	2%	1%	1%	1%
Residual S	3%	3%	2%	2%	2%	1%	1%
	Difference in Dollar Amount						
Super Preferred NS	0.44	1.26	2.07	2.79	4.04	4.81	4.95
Preferred NS	0.58	1.53	2.43	3.21	4.48	5.14	5.10
Residual NS	0.70	1.77	2.75	3.60	4.93	5.51	5.29
Preferred S	1.75	3.65	5.21	6.33	7.51	7.25	6.05
Residual S	1.91	3.94	5.57	6.72	7.87	7.47	6.09

Table 4A continued							
Comparison of CRVM Mean Reserves With and Without Margin							
Average of Results from All Companies							
Whole Life Product							
2-Class Ultimate by Risk Class							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve based on 2017 CSO / Reserve based on 2017 CSO Without Margin						
Nonsmoker	105%	105%	104%	104%	103%	102%	102%
Smoker	106%	106%	105%	105%	104%	103%	102%
	Reserve based on 2001 CSO / Reserve based on 2001 VBT						
Nonsmoker	104%	103%	103%	103%	102%	102%	101%
Smoker	103%	103%	103%	102%	102%	101%	101%
	Difference (2017 - 2001)						
Nonsmoker	2%	2%	1%	1%	1%	1%	1%
Smoker	3%	3%	2%	2%	2%	1%	1%
	Difference in Dollar Amount						
Nonsmoker	0.60	1.59	2.53	3.36	4.81	5.62	5.56
Smoker	1.86	3.86	5.50	6.68	7.96	7.72	6.42

Table 4B							
Comparison of CRVM Mean Reserves With and Without Margin							
Average of Results from All Companies							
Whole Life Product							
5-Class Ultimate by Issue Age							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve based on 2017 CSO / Reserve based on 2017 CSO Without Margin						
25	106%	106%	105%	105%	105%	104%	103%
35	105%	105%	105%	105%	104%	103%	103%
45	105%	105%	105%	104%	104%	103%	102%
55	105%	105%	104%	104%	103%	102%	101%
65	105%	105%	104%	103%	102%	101%	100%
75	105%	104%	103%	102%	101%	100%	
	Reserve based on 2001 CSO / Reserve based on 2001 VBT						
25	105%	105%	104%	104%	103%	103%	102%
35	104%	104%	104%	103%	103%	102%	102%
45	104%	103%	103%	103%	102%	102%	101%
55	103%	103%	103%	102%	102%	101%	100%
65	103%	103%	102%	102%	101%	100%	100%
75	103%	102%	102%	101%	100%	100%	
	Difference (2017 - 2001)						
25	1%	1%	1%	1%	1%	1%	1%
35	1%	1%	1%	1%	1%	1%	1%
45	2%	2%	2%	2%	2%	1%	0%
55	2%	2%	2%	2%	1%	0%	0%
65	2%	2%	2%	1%	0%	0%	0%
75	2%	2%	1%	0%	0%	0%	
	Difference in Dollar Amount						
25	0.02	0.21	0.34	0.59	2.04	4.27	6.57
35	0.06	0.30	0.89	1.81	4.21	6.72	7.27
45	0.46	1.44	2.63	4.07	6.91	7.64	4.06
55	1.09	2.90	4.78	6.58	7.93	4.13	3.15
65	2.17	5.01	7.10	7.97	4.07	3.15	3.68
75	3.67	6.61	6.61	3.39	3.15	3.68	

Table 4B continued							
Comparison of CRVM Mean Reserves With and Without Margin							
Average of Results from All Companies							
Whole Life Product							
2-Class Ultimate by Issue Age							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
25	106%	106%	105%	105%	105%	104%	103%
35	105%	105%	105%	105%	104%	103%	103%
45	105%	105%	105%	105%	104%	103%	102%
55	105%	105%	105%	104%	103%	102%	101%
65	105%	105%	104%	103%	102%	101%	101%
75	105%	104%	104%	103%	101%	101%	
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
25	105%	104%	104%	104%	103%	103%	102%
35	104%	104%	104%	103%	103%	102%	102%
45	104%	103%	103%	103%	102%	102%	101%
55	103%	103%	103%	102%	102%	101%	100%
65	103%	103%	102%	102%	102%	100%	100%
75	103%	103%	102%	102%	101%	100%	
	Difference (2017 - 2001)						
25	1%	1%	1%	1%	1%	1%	1%
35	1%	1%	1%	2%	2%	1%	1%
45	2%	2%	2%	2%	2%	1%	0%
55	2%	2%	2%	2%	1%	0%	0%
65	2%	2%	2%	1%	1%	1%	1%
75	2%	2%	1%	0%	1%	1%	
	Difference in Dollar Amount						
25	0.01	0.20	0.34	0.61	2.14	4.46	6.75
35	0.05	0.31	0.94	1.89	4.37	6.89	7.32
45	0.48	1.47	2.70	4.18	7.04	7.68	4.11
55	1.10	2.94	4.84	6.65	7.95	4.21	4.14
65	2.16	5.03	7.15	8.00	4.25	4.68	5.11
75	3.72	6.75	6.81	3.90	5.67	5.96	

Table 4B continued							
Comparison of CRVM Mean Reserves With and Without Margin							
Average of Results from All Companies							
Whole Life Product							
1-Class Ultimate by Issue Age							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
25	107%	107%	107%	106%	105%	105%	104%
35	108%	108%	107%	106%	105%	104%	103%
45	108%	107%	106%	106%	104%	103%	102%
55	107%	107%	106%	105%	103%	102%	101%
65	107%	107%	107%	105%	103%	101%	101%
75	110%	110%	107%	105%	101%	101%	
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
25	105%	104%	104%	104%	103%	103%	102%
35	104%	104%	104%	103%	103%	102%	102%
45	104%	103%	103%	103%	102%	102%	101%
55	103%	103%	103%	102%	102%	101%	100%
65	103%	103%	102%	102%	101%	100%	100%
75	103%	103%	102%	102%	100%	100%	
	Difference (2017 - 2001)						
25	2%	2%	3%	3%	2%	2%	2%
35	3%	4%	4%	3%	2%	2%	1%
45	4%	4%	3%	3%	2%	1%	1%
55	4%	4%	3%	3%	2%	1%	0%
65	4%	5%	4%	3%	1%	0%	1%
75	7%	7%	5%	3%	1%	1%	
	Difference in Dollar Amount						
25	0.38	1.09	2.03	3.02	4.92	7.13	8.45
35	0.97	2.72	4.45	5.88	8.10	9.36	8.41
45	1.94	4.45	6.55	8.08	9.78	8.94	4.56
55	3.03	6.41	9.47	11.27	10.41	5.17	3.94
65	4.91	12.36	18.87	18.78	8.99	4.36	4.74
75	12.35	27.47	29.99	20.05	5.12	5.35	

20-Year Level Premium Term Product

The analysis presented for the Term product uses reserves calculated based on the formulaic component of VM-20 (NPR) methodology as described in Section 3 of VM-20. The analysis compares reserves on the NPR method using a mean reserve. For the Term product, the highest issue age offered was either 60 or 65, so test issue ages for Term are listed as 25, 35, 45, 55 and 60/65.

The overall impact analysis (Tables 1A, 1B, 1C and 1D) of moving from the 2001 CSO valuation table to the 2017 CSO valuation table demonstrates reduction in mean reserve levels across all durations of the level premium period, with the amount of reduction varying by structure of the table. Below is a summary of the comparison at the overall or highest level of model office aggregation.

2017 CSO Mean Reserve as Percent of 2001 CSO Mean Reserve				
Overall				
	t = 5	t = 10	t = 15	t = 20
5-Class Ultimate	62%	60%	62%	64%
2-Class Ultimate	55%	54%	55%	60%
1-Class Ultimate	71%	65%	68%	70%
5-Class S&U	67%	67%	69%	64%

The following are characteristics of the research outcomes:

- Within the 5-class structure, there is less variance by gender than found in the 2-class or 1-class structures. Residual classes demonstrate more reduction than preferred classes. Nonsmoker risks show more reduction than smoker risks. Test issue age 45 demonstrates more reduction than test issue ages 25, 35, 55 or 60/65.
- Within the 2-class structure, there is more reduction in male risks than female risks; more reduction in nonsmoker risks than smoker risks and more reduction for test issue age 45 (at duration 5) than the other test issue ages; more reduction around test issue ages 35 and 45 at durations 10 and 15 than for the other test issue ages.
- Within the 1-class structure, findings are consistent with the remarks above regarding gender and issue age.

In the aggregation analysis (Table 2A—ultimate basis and Table 2B—S&U basis) the calculated reserves from each of the five risk classes under the preferred structure tables, when weighted by the distribution of face amount from the underlying mortality study data and summed by tobacco class, reproduce to within 1 to 4 percent (depending on duration) the calculated reserves from each of the risk classes under the 2-class structure. Similarly, the 2-class structure, when weighted by the distribution of face amount from the underlying mortality study data and summed, reproduces to within 0 to 5 percent (depending on duration) the calculated reserves on the 1-class structure. See the shaded cells in Tables 2A and 2B for these validation ratios.

Ratios less than 100 percent in the ultimate-to-S&U analysis of Table 3 support the premise that reserves calculated using the ultimate table are less than reserves calculated using the S&U table. The exception to this outcome occurs in duration 20, where the ratio is greater than 100 percent. This is because the terminal reserves in durations 19 and 20 are negative (floored at zero, consistent with the VM-20 NPR methodology) and the mean reserve for duration 20 consists of one-half the valuation net premium. Since net premiums on the S&U basis are less than valuation net premiums on the ultimate basis, the relationship of ultimate to S&U reserves turns around.

The margin analysis for the Term product is based on the S&U table format. The margin analysis of Table 4 indicates that relative margin has increased for reserves calculated using the 2017 CSO table as compared to reserves calculated using the 2001 CSO table. The overall increase in margin between the three table structures (5-class, 2-class and 1-class) is shown below.

Percentage Margin (2017) - Percentage Margin (2001)				
Overall				
	t = 5	t = 10	t = 15	t = 20
5-Class	12%	9%	8%	2%
2-Class	14%	12%	11%	1%
1-Class	14%	11%	10%	3%

It should be noted that a positive relative percentage change in margin does not always translate into a positive dollar amount change in margin. For example, in Table 4A the ratio of reserve based on mortality with margin to reserve based on mortality without margin for the super preferred nonsmoker class at duration 5 under the 2017 tables is 123 percent. The ratio for the 2001 tables is 119 percent, making a difference of 4 percent. The dollar amount difference, however, is \$(0.02). This relationship occurs because the 2017 reserve has dropped more, relative to the 2001 reserve, than have the corresponding reserves without margin. This example is detailed below.

	With Margin	Without Margin	Ratio	Dollar Amount Difference
2017	\$2.37	\$1.93	123%	\$ 0.44
2001	\$2.90	\$2.44	119%	\$ 0.46
Difference			4%	\$(0.02)

When viewed by risk classes (Table 4A) or test issue ages (Table 4B) within each table structure, the results suggest shifts in margin.

For the 5-class structure:

- Residual nonsmoker class carries the least amount of relative change in margin.
- By test issue age, relative margin appears to have shifted from test issue age 25 to test issue ages 35, 45, 55 and 60/65.

For the 2-class structure:

- Both nonsmoker and smoker risks show similar relative margin changes for durations 5, 10 and 15.

- By test issue age, margin appears to have shifted from test issue age 25 to test issue ages 35, 45, 55 and 60/65.

For the 1-class structure:

- By test issue age, margin appears to have shifted from younger test issue age 25 and early durations of test issue age 35 to test issue ages 45, 55 and 60/65.

Term Product Analysis—Overall Impact

Table 1A				
Comparison of VM-20 Net Premium Mean Reserves				
2017 CSO Ultimate Mean Reserve as Percent of 2001 CSO Ultimate Mean Reserve				
Preferred Structure Table (5-class)				
Average of Results from All Companies (5*)				
20-Year Term Product				
	t = 5	t = 10	t = 15	t = 20
Overall	62%	60%	62%	64%
Gender				
Male	61%	60%	61%	64%
Female	62%	62%	62%	64%
Risk Class				
Super Preferred NS	64%	61%	63%	68%
Preferred NS	63%	62%	63%	67%
Residual NS	54%	53%	54%	55%
Preferred S	95%	93%	94%	89%
Residual S	82%	80%	80%	73%
Tobacco Class				
Nonsmoker (NS)	60%	58%	60%	63%
Smoker (S)	87%	85%	85%	79%
Issue Age				
25	87%	90%	115%	89%
35	91%	55%	44%	80%
45	46%	39%	41%	57%
55	50%	62%	65%	59%
60/65	82%	81%	80%	69%
	2017 CSO Reserve - 2001 CSO Reserve in Dollars			
25	(0.07)	(0.06)	0.10	(0.07)
35	(0.08)	(1.18)	(2.34)	(0.26)
45	(1.72)	(8.19)	(9.93)	(1.56)
55	(5.58)	(13.10)	(14.51)	(3.56)
60/65	(4.39)	(13.42)	(18.69)	(7.06)

*Note: One company did not have Residual NT for the 2001 CSO table, so that company's results have been excluded.

Table 1B				
Comparison of VM-20 Net Premium Mean Reserves				
2017 CSO Ultimate Mean Reserve as Percent of 2001 CSO Ultimate Mean Reserve				
Smoking Distinct Structure Table (2-class)				
Average of Results from All Companies (3)				
20-Year Term Product				
	t = 5	t = 10	t = 15	t = 20
Overall	55%	54%	55%	60%
Gender				
Male	50%	48%	49%	55%
Female	65%	64%	65%	69%
Tobacco Class				
Nonsmoker	53%	52%	53%	59%
Smoker	84%	81%	81%	75%
Issue Age				
25	78%	80%	96%	78%
35	79%	32%	27%	80%
45	39%	35%	36%	61%
55	44%	53%	55%	53%
60/65	75%	75%	74%	57%
	2017 CSO Reserve – 2001 CSO Reserve in Dollars			
25	(0.14)	(0.15)	(0.03)	(0.16)
35	(0.21)	(2.26)	(3.06)	(0.23)
45	(2.34)	(9.53)	(10.73)	(1.00)
55	(7.72)	(18.50)	(20.59)	(3.12)
60/65	(7.80)	(23.02)	(30.49)	(8.63)

Table 1C				
Comparison of VM-20 Net Premium Mean Reserves				
2017 CSO Ultimate Mean Reserve as Percent of 2001 CSO Ultimate Mean Reserve				
Unismoke Structure Table (1-class)				
Average of Results from All Companies (4)				
20-Year Term Product				
	t = 5	t = 10	t = 15	t = 20
Overall	71%	65%	68%	70%
Gender				
Male	67%	60%	64%	67%
Female	78%	75%	76%	74%
Issue Age				
25	93%	94%	155%	93%
35	93%	30%	32%	81%
45	44%	45%	52%	62%
55	71%	74%	76%	67%
60/65	87%	85%	83%	73%
	2017 CSO Reserve - 2001 CSO Reserve in Dollars			
25	(0.05)	(0.04)	0.49	(0.06)
35	(0.08)	(2.83)	(3.83)	(0.30)
45	(2.29)	(8.86)	(9.42)	(1.60)
55	(3.85)	(10.35)	(11.73)	(3.17)
60/65	(3.31)	(11.21)	(16.17)	(6.03)

Table 1D				
Comparison of VM-20 Net Premium Mean Reserves				
2017 CSO Select & Ultimate Mean Reserve as Percent of 2001 CSO Select & Ultimate Mean Reserve				
Preferred Structure Table (5-class)				
Average of Results from All Companies (5*)				
20-Year Term Product				
	t = 5	t = 10	t = 15	t = 20
Overall	67%	67%	69%	64%
Gender				
Male	66%	68%	71%	65%
Female	69%	65%	66%	62%
Risk Class				
Super Preferred NS	82%	80%	83%	76%
Preferred NS	71%	71%	74%	69%
Residual NS	50%	52%	54%	50%
Preferred S	114%	101%	99%	94%
Residual S	82%	76%	76%	70%
Tobacco Class				
Nonsmoker (NS)	64%	65%	68%	63%
Smoker (S)	93%	84%	84%	79%
Issue Age				
25	78%	78%	76%	78%
35	60%	43%	50%	62%
45	46%	57%	60%	55%
55	66%	66%	67%	58%
60/65	84%	83%	86%	80%
	2017 CSO Reserve - 2001 CSO Reserve			
	in Dollars			
25	(0.10)	(0.13)	(0.23)	(0.12)
35	(0.34)	(2.00)	(2.48)	(0.44)
45	(2.05)	(5.51)	(6.30)	(1.40)
55	(4.33)	(12.27)	(14.39)	(3.30)
60/65	(4.63)	(13.16)	(13.85)	(4.03)

*Note: One company did not have Residual NT for the 2001 CSO table, so that company's results have been excluded.

Term Product Analysis—Aggregation Analysis

Table 2A							
Risk Class Aggregation Analysis							
2017 CSO Ultimate							
Results from One Company Providing All Table Structures							
20-Year Term Product							
	t = 5	t = 10	t = 15	t = 20			
5-Class Structure	A) Reserve Per Unit						
Super Preferred NS	2.71	7.90	9.92	1.99			
Preferred NS	3.13	9.30	11.52	2.29			
Residual NS	3.56	10.60	13.12	2.61			
Preferred S	7.10	21.19	25.88	4.65			
Residual S	7.92	23.68	28.70	5.26			
	B) Table Development Weightings (SOA), Preferred Class Structure						
Super Preferred NS	40%	40%	40%	40%			
Preferred NS	27%	27%	27%	27%			
Residual NS	32%	32%	32%	32%			
Preferred S	64%	64%	64%	64%			
Residual S	36%	36%	36%	36%			
	C) Sum of (A * B) by Tobacco Class						
Nonsmoker (NS)	3.07	9.06	11.28	2.25			
Smoker (S)	7.39	22.09	26.90	4.87			
2-Class Structure	D) Reserve Per Unit						
Nonsmoker	3.18	9.45	11.70	2.32			
Smoker	7.57	22.49	27.35	4.90			
	E) Validation (C/D)						
Nonsmoker	97%	96%	96%	97%			
Smoker	98%	98%	98%	99%			
	F) Table Development Weightings (SOA), Smoking Class Structure						
Nonsmoker	73%	73%	73%	73%			
Smoker	27%	27%	27%	27%			
	G) Sum of (D * F)						
Unismoke	4.36	12.97	15.92	3.01			
1-Class Structure	H) Reserve Per Unit						
Unismoke	4.37	12.42	15.51	2.96			
	I) Validation (G/H)						
Unismoke	100%	104%	103%	102%			

Table 2B							
Risk Class Aggregation Analysis							
2017 CSO Select & Ultimate							
Results from One Company Providing All Table Structures							
20-Year Term Product							
	t = 5	t = 10	t = 15	t = 20			
5-Class Structure	A) Reserve Per Unit						
Super Preferred NS	3.02	8.82	11.34	1.58			
Preferred NS	3.68	10.63	13.39	1.83			
Residual NS	4.47	12.58	15.60	2.10			
Preferred S	11.20	26.34	30.28	4.27			
Residual S	12.87	29.81	33.98	4.83			
	B) Table Development Weightings (SOA), Preferred Class Structure						
Super Preferred NS	40%	40%	40%	40%			
Preferred NS	27%	27%	27%	27%			
Residual NS	32%	32%	32%	32%			
Preferred S	64%	64%	64%	64%			
Residual S	36%	36%	36%	36%			
	C) Sum of (A * B) by Tobacco Class						
Nonsmoker (NS)	3.63	10.42	13.14	1.80			
Smoker (S)	11.80	27.59	31.61	4.48			
2-Class Structure	D) Reserve Per Unit						
Nonsmoker	3.76	10.84	13.62	1.86			
Smoker	11.98	27.95	31.96	4.53			
	E) Validation (C/D)						
Nonsmoker	97%	96%	97%	97%			
Smoker	99%	99%	99%	99%			
	F) Table Development Weightings (SOA), Smoking Class Structure						
Nonsmoker	73%	73%	73%	73%			
Smoker	27%	27%	27%	27%			
	G) Sum of (D * F)						
Unismoke	5.98	15.46	18.57	2.58			
1-Class Structure	H) Reserve Per Unit						
Unismoke	5.81	15.31	18.61	2.45			
	I) Validation (G/H)						
Unismoke	103%	101%	100%	105%			

Term Product Analysis—Ultimate-to-S&U Analysis

Table 3				
Comparison of VM-20 Net Premium Mean Reserves				
2017 CSO Ultimate Mean Reserve as a Percent of 2017 CSO Select & Ultimate Mean Reserve				
Average of Results from All Companies				
20-Year Term Product				
	t = 5	t = 10	t = 15	t = 20
5-Class Structure (6)				
Super Preferred NS	86%	88%	88%	122%
Preferred NS	83%	87%	88%	120%
Residual NS	78%	84%	86%	119%
Preferred S	64%	81%	86%	100%
Residual S	63%	80%	86%	101%
2-Class Structure (3)				
Nonsmoker (NS)	83%	86%	85%	132%
Smoker (S)	63%	80%	85%	111%
1-Class Structure (1)				
Unismoke	75%	81%	83%	121%

Term Product Analysis—Margin Analysis

Table 4				
Comparison of VM-20 Net Premium Mean Reserves With and Without Margin				
Average of Results from All Companies				
20-Year Term Product				
5-Class Select & Ultimate (5)				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
Overall	123%	121%	121%	120%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
Overall	111%	112%	113%	118%
	Difference (2017 - 2001)			
Overall	12%	9%	8%	2%
	Difference in Dollar Amount			
Overall	0.12	0.11	0.10	(0.18)
2-Class Select & Ultimate (3)				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
Overall	123%	121%	121%	120%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
Overall	108%	109%	110%	119%
	Difference (2017 - 2001)			
Overall	14%	12%	11%	1%
	Difference in Dollar Amount			
Overall	0.13	0.15	0.11	(0.20)
1-Class Select & Ultimate (1)				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
Overall	122%	120%	120%	120%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
Overall	108%	109%	110%	117%
	Difference (2017 - 2001)			
Overall	14%	11%	10%	3%
	Difference in Dollar Amount			
Overall	0.44	0.76	0.82	(0.10)

Table 4A				
Comparison of VM-20 Net Premium Mean Reserves With and Without Margin				
Average of Results from All Companies				
20-Year Term Product				
5-Class Select & Ultimate by Risk Class				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
Super Preferred NS	123%	122%	121%	120%
Preferred NS	124%	122%	121%	120%
Residual NS	124%	121%	121%	120%
Preferred S	121%	119%	119%	122%
Residual S	121%	119%	119%	122%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
Super Preferred NS	119%	119%	118%	126%
Preferred NS	113%	114%	114%	120%
Residual NS	128%	120%	117%	129%
Preferred S	107%	108%	109%	113%
Residual S	105%	106%	107%	110%
	Difference (2017 - 2001)			
Super Preferred NS	4%	3%	3%	(6%)
Preferred NS	11%	8%	7%	0%
Residual NS	(4%)	2%	4%	(9%)
Preferred S	13%	11%	10%	9%
Residual S	16%	13%	12%	12%
	Difference in Dollar Amount			
Super Preferred NS	(0.02)	(0.16)	(0.14)	(0.20)
Preferred NS	0.09	0.09	0.07	(0.18)
Residual NS	0.17	0.21	0.14	(0.23)
Preferred S	1.14	2.14	2.28	0.28
Residual S	1.39	2.51	2.62	0.28

Table 4A continued				
Comparison of VM-20 Net Premium Mean Reserves With and Without Margin				
Average of Results from All Companies				
20-Year Term Product				
2-Class Select & Ultimate by Risk Class				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
Nonsmoker (NS)	123%	121%	121%	119%
Smoker (S)	120%	119%	119%	122%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
Nonsmoker	109%	110%	110%	120%
Smoker	105%	106%	107%	113%
	Difference (2017 - 2001)			
Nonsmoker	14%	12%	11%	0%
Smoker	15%	13%	12%	9%
	Difference in Dollar Amount			
Nonsmoker	0.08	0.05	0.01	(0.21)
Smoker	1.27	2.27	2.30	0.12

Table 4B				
Comparison of VM-20 Net Premium Mean Reserves With and Without Margin				
Average of Results from All Companies				
20-Year Term Product				
5-Class Select & Ultimate by Issue Age				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
25	112%	118%	141%	114%
35	116%	144%	130%	110%
45	135%	124%	120%	110%
55	124%	120%	120%	120%
60/65	119%	117%	117%	123%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
25	125%	128%	140%	126%
35	129%	129%	124%	127%
45	116%	114%	114%	120%
55	110%	110%	111%	117%
60/65	107%	109%	109%	114%
	Difference (2017 - 2001)			
25	(13%)	(11%)	1%	(12%)
35	(13%)	14%	6%	(16%)
45	19%	10%	6%	(10%)
55	15%	9%	9%	3%
60/65	11%	9%	8%	9%
	Difference in Dollar Amount			
25	(0.05)	(0.06)	(0.06)	(0.06)
35	(0.12)	(0.32)	(0.35)	(0.17)
45	(0.06)	(0.13)	(0.37)	(0.34)
55	0.58	0.58	0.49	(0.36)
60/65	1.53	2.53	3.04	0.04

Table 4B continued				
Comparison of VM-20 Net Premium Mean Reserves With and Without Margin				
Average of Results from All Companies				
20-Year Term Product				
2-Class Select & Ultimate by Issue Age				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
25	112%	118%	124%	112%
35	117%	160%	140%	114%
45	141%	126%	124%	116%
55	124%	120%	120%	118%
60/65	118%	117%	117%	126%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
25	121%	122%	147%	121%
35	125%	121%	118%	126%
45	111%	111%	112%	122%
55	107%	108%	109%	120%
60/65	106%	107%	108%	114%
	Difference (2017 - 2001)			
25	(10%)	(5%)	(23%)	(10%)
35	(8%)	40%	21%	(12%)
45	29%	15%	13%	(6%)
55	17%	12%	11%	(2%)
60/65	12%	10%	10%	11%
	Difference in Dollar Amount			
25	(0.05)	(0.05)	(0.18)	(0.06)
35	(0.11)	(0.27)	(0.25)	(0.13)
45	(0.07)	(0.09)	(0.19)	(0.22)
55	0.54	0.42	0.22	(0.50)
60/65	2.03	3.67	4.47	(0.01)

Table 4B continued				
Comparison of VM-20 Net Premium Mean Reserves With and Without Margin				
Average of Results from All Companies				
20-Year Term Product				
1-Class Select & Ultimate by Issue Age				
	t = 5	t = 10	t = 15	t = 20
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin			
25	113%	113%	159%	113%
35	115%	144%	132%	115%
45	139%	124%	123%	117%
55	121%	119%	119%	120%
60/65	116%	116%	116%	122%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT			
25	120%	120%	160%	120%
35	129%	118%	117%	124%
45	110%	110%	111%	121%
55	107%	108%	109%	119%
60/65	105%	106%	107%	112%
	Difference (2017 - 2001)			
25	(7%)	(7%)	(1%)	(7%)
35	(15%)	26%	15%	(9%)
45	29%	13%	12%	(4%)
55	14%	11%	10%	1%
60/65	11%	9%	9%	10%
	Difference in Dollar Amount			
25	(0.04)	(0.05)	(0.00)	(0.05)
35	(0.14)	(0.03)	(0.08)	(0.11)
45	0.37	0.45	0.39	(0.17)
55	1.29	1.91	1.86	(0.39)
60/65	3.17	6.11	7.79	0.97

ULSG Product

The analysis presented for the ULSG product uses reserves calculated based on the formulaic component of VM-20 (NPR) methodology as described in Section 3 of VM-20. The analysis compares reserves on the NPR method and using a point-in-time reserve rather than a mean reserve.

The overall impact analysis (Tables 1A, 1B and 1C) of moving from the 2001 CSO valuation table to the 2017 CSO valuation table shows a 5 to 11 percent reduction in duration 5 mean reserves, depending on the structure of the table used. This reduction grades off as the policy duration increases to maturity, but unlike the WL product, some reduction remains in the later policy years. A summary of the overall results is listed below.

2017 CSO Mean Reserve as Percent of 2001 CSO Mean Reserve							
Overall							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Ultimate	92%	90%	91%	91%	93%	94%	95%
2-Class Ultimate	89%	86%	87%	88%	90%	92%	92%
1-Class Ultimate	95%	93%	93%	94%	95%	97%	98%

The following characteristics of the research outcomes are consistent between the 5-class, 2-class and 1-class structure tables.

- A greater reduction is attributable to male risks than to female risks.
- A greater reduction is attributable to non-tobacco risks than to tobacco risks.
- Within the 5-class structure, more reduction is evident in the residual class than in the preferred classes.
- Test issue ages 25, 35 and 45 demonstrate more reduction than do test issue ages 55, 65 and 75.
- Reserve increases are found at test issue age 75.

The last characteristic is consistent with the slope of the 2017 CSO at higher attained ages being steeper than the slope of the 2001 CSO at those attained ages.

In the aggregation analysis (Table 2A—Ultimate basis and Table 2B—S&U basis) the calculated reserves from each of the five risk classes under the preferred structure tables, when weighted by the distribution of face amount from the underlying mortality study data and summed by tobacco class, reproduce to within 2 percent the calculated reserves from each of the risk classes under the 2-class structure. Similarly the 2-class structure, when weighted by the distribution of face amount from the underlying mortality study data and summed, reproduces to within 3 percent the calculated reserves on the 1-class structure. See the shaded cells in Tables 2A and 2B for these validation ratios.

Ratios less than 100 percent in the ultimate-to-S&U analysis of Table 3 support the premise that reserves calculated using the ultimate table are less than reserves calculated using the S&U table. For the ULSG product, this ratio is much closer to 100 percent than for either of the other two

product types. For this reason Table 3 is shown to an additional decimal place. The VM-20 NPR method for ULSG products is a percentage (not greater than 100 percent) of a net single premium less an expense allowance that is based on valuation net premiums. The ratio is a no-lapse guarantee funding ratio. The ULSG NPR is therefore largely driven by the net single premium, and has no offsetting present value of valuation net premium component. The valuation net premium enters the formula only through the expense allowance factor.

The margin analysis of Tables 4, 4A and 4B indicates that relative margin has increased in the 2017 CSO table as compared to the 2001 CSO table. Overall, the increase in margin between the three table structures (5-class, 2-class and 1-class) is similar. When viewed by risk classes (Table 4A) or issue ages (Table 4B) within each table, the results suggest shifts in margin.

For the 5-class structure:

Both residual classes carry the greatest amount of change in margin (with the exception of the duration 5 residual nonsmoker).

By test issue age, margin appears to have shifted from test issue ages 25 and 35 to test issue ages 45, 55, 65 and 75.

For the 2-class structure:

Both nonsmoker and smoker risks show similar degrees of increase in margin.

By test issue age, margin appears to have shifted from test issue ages 25 and 35 to test issue ages 45, 55, 65 and 75.

For the 1-class structure:

By test issue age, shift in relative margin is more evenly spread over the test issue ages.

ULSG Product Analysis—Overall Impact

Table 1A							
Comparison of VM-20 Net Premium Reserves							
2017 CSO Ultimate Reserve as Percent of 2001 CSO Ultimate Reserve							
Preferred Structure Table (5-class)							
Average of Results from All Companies (1)							
ULSG Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
Overall	92%	90%	91%	91%	93%	94%	95%
Gender							
Male	91%	88%	89%	89%	90%	91%	92%
Female	92%	91%	93%	93%	95%	97%	99%
Risk Class							
Super Preferred NS	93%	91%	92%	93%	94%	95%	96%
Preferred NS	92%	91%	92%	92%	93%	95%	96%
Residual NS	89%	86%	87%	88%	90%	92%	93%
Preferred S	99%	99%	99%	99%	100%	100%	101%
Residual S	98%	97%	98%	98%	99%	99%	99%
Tobacco Class							
Nonsmoker (NS)	91%	89%	90%	91%	92%	94%	95%
Smoker (S)	99%	98%	98%	98%	99%	99%	100%
Issue Age							
25	86%	85%	84%	83%	84%	87%	92%
35	84%	83%	83%	84%	87%	92%	97%
45	85%	84%	85%	88%	92%	97%	NA
55	89%	89%	91%	93%	97%	NA	NA
65	97%	94%	96%	98%	NA	NA	NA
75	119%	102%	103%	NA	NA	NA	
	2017 CSO Reserve - 2001 CSO Reserve in Dollars						
25	(0.71)	(3.54)	(8.20)	(14.93)	(30.99)	(41.24)	(37.92)
35	(1.95)	(7.76)	(15.34)	(24.13)	(36.95)	(35.90)	(19.48)
45	(3.00)	(11.36)	(20.27)	(27.44)	(31.08)	(17.68)	
55	(3.52)	(12.55)	(19.25)	(22.42)	(14.42)		
65	(1.33)	(8.43)	(11.41)	(8.32)			
75	4.84	2.48	5.34				

Table 1B							
Comparison of VM-20 Net Premium Reserves							
2017 CSO Ultimate Reserve as Percent of 2001 CSO Ultimate Reserve							
Smoking Distinct Structure Table (2-class)							
Average of Results from All Companies (1)							
ULSG Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
Overall	89%	86%	87%	88%	90%	92%	92%
Gender							
Male	89%	85%	86%	86%	88%	89%	90%
Female	89%	88%	89%	90%	92%	94%	96%
Tobacco Class							
Nonsmoker	89%	86%	87%	88%	89%	91%	93%
Smoker	96%	94%	95%	95%	96%	97%	98%
Issue Age							
25	80%	79%	78%	78%	79%	83%	89%
35	79%	78%	78%	79%	83%	89%	95%
45	81%	80%	81%	84%	89%	95%	NA
55	86%	85%	87%	90%	95%	NA	NA
65	96%	92%	94%	96%	NA	NA	NA
75	129%	102%	103%	NA	NA	NA	NA
	2017 CSO Reserve - 2001 CSO Reserve in Dollars						
25	(1.05)	(5.38)	(12.03)	(21.14)	(42.21)	(57.08)	(54.60)
35	(2.74)	(10.86)	(21.10)	(32.74)	(51.06)	(51.66)	(30.14)
45	(3.97)	(15.28)	(27.46)	(37.91)	(44.81)	(27.50)	
55	(4.67)	(17.41)	(27.41)	(32.54)	(22.73)		
65	(1.96)	(12.42)	(16.76)	(13.55)			
75	6.69	2.81	5.39				

Table 1C							
Comparison of VM-20 Net Premium Reserves							
2017 CSO Ultimate Reserve as Percent of 2001 CSO Ultimate Reserve							
Unismoke Structure Table (1-class)							
Average of Results from All Companies (1)							
ULSG Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
Overall	95%	93%	93%	94%	95%	97%	98%
Gender							
Male	92%	89%	89%	90%	91%	92%	93%
Female	97%	96%	98%	98%	100%	102%	103%
Issue Age							
25	88%	87%	86%	85%	87%	91%	95%
35	87%	85%	86%	87%	91%	95%	99%
45	88%	87%	89%	91%	95%	99%	NA
55	93%	92%	94%	95%	99%	NA	NA
65	100%	97%	98%	100%	NA	NA	NA
75	122%	104%	106%	NA	NA	NA	
	2017 CSO Reserve – 2001 CSO Reserve						
	in Dollars						
25	(0.64)	(3.38)	(7.78)	(14.16)	(27.62)	(32.46)	(26.71)
35	(1.79)	(7.34)	(14.26)	(21.47)	(29.02)	(25.21)	(6.31)
45	(2.61)	(9.87)	(16.51)	(21.19)	(21.48)	(5.20)	
55	(2.31)	(9.14)	(13.51)	(14.97)	(3.31)		
65	0.09	(4.69)	(5.53)	0.03			
75	5.03	6.27	11.20				

ULSG Product Analysis—Aggregation Analysis

Table 2A							
Risk Class Aggregation Analysis							
2017 CSO Ultimate							
Results from One Company Providing All Table Structures							
ULSG Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Structure	A) Reserve Per Unit						
Super Preferred NS	20.93	74.89	137.49	206.44	329.46	429.78	504.94
Preferred NS	22.40	79.11	144.09	215.00	340.66	441.78	516.52
Residual NS	23.75	83.12	150.59	224.25	353.01	455.25	529.93
Preferred S	28.25	97.74	173.55	256.59	402.97	514.09	592.86
Residual S	28.22	100.84	178.70	263.98	412.03	523.21	601.07
	B) Table Development Weightings (SOA), Preferred Class Structure						
Super Preferred NS	40%	40%	40%	40%	40%	40%	40%
Preferred NS	27%	27%	27%	27%	27%	27%	27%
Residual NS	32%	32%	32%	32%	32%	32%	32%
Preferred S	64%	64%	64%	64%	64%	64%	64%
Residual S	36%	36%	36%	36%	36%	36%	36%
	C) Sum of (A * B) by Tobacco Class						
Nonsmoker (NS)	22.02	77.91	142.09	212.39	336.73	436.87	511.01
Smoker (S)	28.24	98.86	175.41	259.25	406.23	517.37	595.81
2-Class Structure	D) Reserve Per Unit						
Nonsmoker	22.39	79.27	144.49	215.86	341.92	443.16	517.91
Smoker	28.11	99.16	175.96	260.16	407.39	518.55	596.82
	E) Validation (C/D)						
Nonsmoker	98%	98%	98%	98%	98%	99%	99%
Smoker	100%	100%	100%	100%	100%	100%	100%
	F) Table Development Weightings (SOA), Smoking Class Structure						
Nonsmoker	73%	73%	73%	73%	73%	73%	73%
Smoker	27%	27%	27%	27%	27%	27%	27%
	G) Sum of (D * F)						
Unismoke	23.93	84.64	152.99	227.83	359.60	463.52	539.21
1-Class Structure	H) Reserve Per Unit						
Unismoke	24.18	86.70	157.30	233.95	367.79	472.67	548.10
	I) Validation (G/H)						
Unismoke	99%	98%	97%	97%	98%	98%	98%

Table 2B							
Risk Class Aggregation Analysis							
2017 CSO Select & Ultimate							
Results from One Company Providing All Table Structures							
ULSG Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Structure	A) Reserve Per Unit						
Super Preferred NS	21.18	74.66	138.04	207.23	330.05	430.14	505.17
Preferred NS	22.75	79.01	144.80	215.93	341.30	442.16	516.77
Residual NS	24.25	83.25	151.55	225.31	353.71	455.67	530.21
Preferred S	30.11	99.38	175.45	257.95	403.59	514.45	593.05
Residual S	29.91	102.82	180.99	265.70	412.80	523.62	601.28
	B) Table Development Weightings (SOA), Preferred Class Structure						
Super Preferred NS	40%	40%	40%	40%	40%	40%	40%
Preferred NS	27%	27%	27%	27%	27%	27%	27%
Residual NS	32%	32%	32%	32%	32%	32%	32%
Preferred S	64%	64%	64%	64%	64%	64%	64%
Residual S	36%	36%	36%	36%	36%	36%	36%
	C) Sum of (A * B) by Tobacco Class						
Nonsmoker (NS)	22.38	77.84	142.81	213.29	337.36	437.25	511.26
Smoker (S)	30.04	100.62	177.45	260.74	406.91	517.75	596.01
2-Class Structure	D) Reserve Per Unit						
Nonsmoker	22.76	79.20	145.22	216.80	342.56	443.54	518.15
Smoker	29.84	100.97	178.02	261.64	408.02	518.89	597.00
	E) Validation (C/D)						
Nonsmoker	98%	98%	98%	98%	98%	99%	99%
Smoker	101%	100%	100%	100%	100%	100%	100%
	F) Table Development Weightings (SOA), Smoking Class Structure						
Nonsmoker	73%	73%	73%	73%	73%	73%	73%
Smoker	27%	27%	27%	27%	27%	27%	27%
	G) Sum of (D * F)						
Unismoke	24.68	85.08	154.08	228.91	360.23	463.89	539.44
1-Class Structure	H) Reserve Per Unit						
Unismoke	24.98	87.04	158.57	235.32	368.47	473.11	548.40
	I) Validation (G/H)						
Unismoke	99%	98%	97%	97%	98%	98%	98%

ULSG Product Analysis—Ultimate-to-S&U Analysis

Ratios less than 100 percent in the ultimate-to-S&U analysis of Table 3 support the premise that reserves calculated using the ultimate table are less than reserves calculated using the S&U table. For the ULSG product, this ratio is much closer to 100 percent than for either of the other two product types tested. For this reason, values reported in the table below are shown to one more decimal place than are the ratios in the comparable table for other product types.

Table 3							
Comparison of VM-20 Net Premium Reserves							
2017 CSO Ultimate Reserve as a Percent of 2017 CSO Select & Ultimate Reserve							
Average of Results from All Companies (1)							
ULSG Product							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
5-Class Structure (1)							
Super Pref NS	98.8%	100.3%	99.6%	99.6%	99.8%	99.9%	100.0%
Preferred NS	98.5%	100.1%	99.5%	99.6%	99.8%	99.9%	100.0%
Residual NS	98.0%	99.8%	99.4%	99.5%	99.8%	99.9%	99.9%
Preferred S	93.8%	98.4%	98.9%	99.5%	99.8%	99.9%	100.0%
Residual S	94.3%	98.1%	98.7%	99.4%	99.8%	99.9%	100.0%
2-Class Structure (1)							
Nonsmoker	98.3%	100.1%	99.5%	99.6%	99.8%	99.9%	100.0%
Smoker	94.2%	98.2%	98.8%	99.4%	99.8%	99.9%	100.0%
1-Class Structure (1)							
Unismoke	96.8%	99.6%	99.2%	99.4%	99.8%	99.9%	99.9%

ULSG Product Analysis—Margin Analysis

Table 4							
Comparison of VM-20 Net Premium Reserves With and Without Margin							
Average of Results from All Companies							
ULSG Product							
5-Class Ultimate (1)							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Overall	107%	109%	109%	109%	109%	109%	109%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Overall	104%	105%	105%	105%	105%	105%	105%
	Difference (2017 - 2001)						
Overall	3%	3%	3%	3%	3%	4%	4%
	Difference in Dollar Amount						
Overall	0.53	1.74	3.36	5.25	8.95	12.30	15.01
2-Class Ultimate (1)							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Overall	107%	109%	109%	109%	109%	109%	109%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Overall	104%	105%	105%	105%	105%	105%	105%
	Difference (2017 - 2001)						
Overall	4%	4%	4%	4%	4%	4%	4%
	Difference in Dollar Amount						
Overall	0.62	1.89	3.58	5.54	9.37	12.81	15.54
1-Class Ultimate (1)							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Overall	107%	108%	108%	108%	108%	108%	108%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Overall	104%	105%	105%	105%	105%	105%	105%
	Difference (2017 - 2001)						
Overall	3%	3%	3%	3%	3%	3%	3%
	Difference in Dollar Amount						
Overall	0.61	2.15	4.07	6.18	10.12	13.42	15.93

Table 4A							
Comparison of VM-20 Net Premium Reserves With and Without Margin							
Average of Results from All Companies							
ULSG Product							
5-Class Ultimate by Risk Class							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Super Preferred NS	108%	109%	109%	109%	109%	109%	109%
Preferred NS	107%	109%	109%	109%	109%	109%	109%
Residual NS	107%	108%	109%	109%	108%	108%	108%
Preferred S	105%	107%	107%	107%	107%	107%	107%
Residual S	105%	107%	107%	107%	107%	107%	107%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Super Preferred NS	105%	106%	106%	106%	106%	106%	106%
Preferred NS	105%	106%	106%	106%	106%	105%	105%
Residual NS	108%	104%	102%	102%	103%	104%	104%
Preferred S	103%	104%	104%	104%	104%	104%	104%
Residual S	100%	100%	100%	100%	100%	101%	102%
	Difference (2017 - 2001)						
Super Preferred NS	2%	2%	3%	3%	3%	3%	3%
Preferred NS	3%	3%	3%	3%	3%	3%	3%
Residual NS	-1%	5%	6%	6%	5%	5%	4%
Preferred S	2%	3%	3%	3%	3%	3%	3%
Residual S	5%	7%	7%	7%	7%	6%	6%
	Difference in Dollar Amount						
Super Preferred NS	0.37	1.14	2.39	3.95	7.23	10.51	13.35
Preferred NS	0.45	1.52	3.00	4.76	8.27	11.58	14.31
Residual NS	0.70	2.12	3.95	6.04	10.00	13.45	16.13
Preferred S	0.63	2.67	4.93	7.34	11.54	14.61	16.79
Residual S	1.46	7.09	12.43	17.81	25.60	29.37	30.51

Table 4A							
Comparison of VM-20 Net Premium Reserves With and Without Margin							
Average of Results from All Companies							
ULSG Product							
2-Class Ultimate by Risk Class							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
Nonsmoker	107%	109%	109%	109%	109%	109%	109%
Smoker	105%	107%	107%	107%	107%	107%	107%
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
Nonsmoker	104%	105%	105%	105%	105%	105%	105%
Smoker	102%	103%	104%	104%	104%	104%	104%
	Difference (2017 - 2001)						
Nonsmoker	4%	4%	4%	4%	4%	4%	4%
Smoker	3%	4%	4%	4%	4%	3%	3%
	Difference in Dollar Amount						
Nonsmoker	0.62	1.84	3.49	5.43	9.24	12.68	15.44
Smoker	0.75	3.05	5.51	8.14	12.62	15.80	17.96

Table 4B							
Comparison of VM-20 Net Premium Reserves With and Without Margin							
Average of Results from All Companies							
ULSG Product							
5-Class Ultimate by Issue Age							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
25	110%	111%	110%	110%	109%	109%	108%
35	110%	110%	110%	109%	109%	108%	109%
45	109%	109%	109%	109%	108%	109%	NA
55	108%	109%	108%	108%	109%	NA	NA
65	106%	108%	108%	109%	NA	NA	NA
75	102%	108%	111%	NA	NA	NA	
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
25	109%	109%	108%	108%	107%	106%	105%
35	107%	108%	107%	107%	106%	105%	105%
45	106%	106%	106%	106%	105%	105%	NA
55	104%	105%	105%	105%	105%	NA	NA
65	103%	104%	105%	105%	NA	NA	NA
75	98%	104%	107%	NA	NA	NA	
	Difference (2017 - 2001)						
25	2%	2%	2%	2%	3%	3%	3%
35	2%	2%	3%	3%	3%	3%	4%
45	3%	3%	3%	3%	3%	4%	NA
55	3%	3%	3%	3%	4%	NA	NA
65	3%	3%	4%	4%	NA	NA	NA
75	4%	4%	4%	NA	NA	NA	
	Difference in Dollar Amount						
25	0.00	0.02	0.09	0.32	2.02	5.72	11.37
35	0.07	0.21	0.67	1.62	5.18	10.84	16.62
45	0.27	0.91	2.12	4.05	9.69	15.69	
55	0.71	2.25	4.55	7.58	13.95		
65	1.33	4.08	7.29	10.58			
75	1.09	4.64	7.12				

Table 4B continued							
Comparison of VM-20 Net Premium Reserves With and Without Margin							
Average of Results from All Companies							
ULSG Product							
2-Class Ultimate by Issue Age							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
25	110%	111%	110%	110%	109%	109%	108%
35	110%	110%	110%	109%	109%	108%	109%
45	109%	109%	109%	109%	108%	109%	NA
55	108%	108%	108%	108%	109%	NA	NA
65	106%	108%	108%	109%	NA	NA	NA
75	102%	108%	111%	NA	NA	NA	
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
25	108%	108%	108%	107%	106%	105%	105%
35	107%	107%	107%	106%	105%	105%	105%
45	105%	106%	105%	105%	105%	105%	NA
55	104%	105%	105%	104%	105%	NA	NA
65	102%	104%	104%	105%	NA	NA	NA
75	97%	104%	106%	NA	NA	NA	
	Difference (2017 - 2001)						
25	2%	2%	3%	3%	3%	4%	4%
35	3%	3%	3%	3%	4%	4%	4%
45	3%	3%	4%	4%	4%	4%	NA
55	4%	4%	4%	4%	4%	NA	NA
65	4%	4%	4%	4%	NA	NA	NA
75	5%	4%	4%	NA	NA	NA	
	Difference in Dollar Amount						
25	0.01	0.00	0.07	0.31	2.16	6.13	12.02
35	0.07	0.21	0.71	1.73	5.55	11.47	17.11
45	0.32	1.00	2.30	4.35	10.26	16.15	
55	0.83	2.46	4.89	8.05	14.38		
65	1.58	4.43	7.72	10.97			
75	1.22	5.08	7.43				

Table 4B continued							
Comparison of VM-20 Net Premium Reserves With and Without Margin							
Average of Results from All Companies							
ULSG Product							
1-Class Ultimate by Issue Age							
	t = 5	t = 10	t = 15	t = 20	t = 30	t = 40	t = 50
	Reserve Based on 2017 CSO / Reserve Based on 2017 CSO Without Margin						
25	110%	111%	110%	110%	109%	108%	108%
35	109%	110%	109%	109%	108%	108%	108%
45	108%	109%	109%	108%	108%	108%	NA
55	107%	108%	108%	108%	108%	NA	NA
65	105%	107%	108%	108%	NA	NA	NA
75	99%	107%	110%	NA	NA	NA	
	Reserve Based on 2001 CSO / Reserve Based on 2001 VBT						
25	108%	108%	108%	107%	106%	105%	105%
35	107%	107%	106%	106%	105%	105%	105%
45	105%	106%	105%	105%	104%	105%	NA
55	104%	105%	105%	104%	105%	NA	NA
65	102%	104%	104%	105%	NA	NA	NA
75	96%	104%	106%	NA	NA	NA	
	Difference (2017 - 2001)						
25	2%	3%	3%	3%	3%	3%	3%
35	3%	3%	3%	3%	3%	3%	3%
45	3%	3%	3%	3%	3%	3%	NA
55	3%	3%	3%	3%	3%	NA	NA
65	3%	3%	3%	3%	NA	NA	NA
75	2%	3%	4%	NA	NA	NA	
	Difference in Dollar Amount						
25	0.05	0.24	0.56	1.07	3.44	7.71	12.79
35	0.17	0.58	1.36	2.71	6.96	12.19	17.33
45	0.40	1.43	3.11	5.39	10.88	16.35	
55	0.91	2.89	5.46	8.45	14.50		
65	1.36	4.35	7.56	10.90			
75	0.43	4.54	7.41				

Auxiliary Items

Cash Values on 30-Year Level Premium Term

Using the 2017 CSO ultimate smoking distinct (2-class) mortality table and 4.5 percent interest, calculations were made using the Standard Nonforfeiture Law method for minimum cash values. The product tested is a 30-year level premium term insurance to age 95. Issue ages under this company's product are 16 through 50.

The company submitting these results recalibrated gross premiums during the post-level term period to 300 percent of valuation mortality rates. No cash values develop under these assumptions for the minimum methodology.

Terminal Cash Values per \$1,000 of Insurance 30-Year Level Premium Term Insurance to Age 95 2017 CSO Ultimate 2-Class													
Policy Year	25MN	30MN	35MN	40MN	45MN	50MN		25MS	30MS	35MS	40MS	45MS	50MS
10	(24.72)	(28.34)	(35.97)	(39.19)	(39.32)	(34.87)		(24.54)	(25.95)	(34.96)	(34.43)	(20.78)	(1.60)
20	(47.88)	(58.14)	(75.58)	(87.28)	(97.40)	(106.04)		(48.81)	(59.94)	(86.96)	(96.82)	(93.47)	(103.33)
30	(96.62)	(124.51)	(172.97)	(227.98)	(316.63)	(481.77)		(119.77)	(164.67)	(269.10)	(388.06)	(554.84)	(876.01)
40	(137.21)	(173.51)	(233.84)	(293.88)	(376.41)	(461.54)		(162.20)	(214.57)	(334.80)	(457.92)	(615.42)	(806.99)
50	(185.49)	(223.66)	(277.99)	(281.53)	0.00			(201.80)	(253.20)	(371.36)	(421.84)	0.00	
60	(220.51)	(214.26)	0.00					(223.83)	(233.25)	0.00			
Policy Year	25FN	30FN	35FN	40FN	45FN	50FN		25FS	30FS	35FS	40FS	45FS	50FS
10	(22.03)	(26.04)	(30.66)	(31.69)	(32.78)	(32.72)		(19.48)	(23.27)	(30.72)	(32.22)	(27.94)	(15.28)
20	(40.70)	(48.00)	(58.11)	(66.63)	(78.54)	(89.02)		(36.72)	(48.54)	(71.15)	(89.03)	(105.34)	(115.57)
30	(75.85)	(97.07)	(129.10)	(166.37)	(229.16)	(336.93)		(88.68)	(132.84)	(218.12)	(328.08)	(480.76)	(690.94)
40	(108.34)	(136.29)	(176.69)	(217.49)	(272.41)	(310.03)		(120.91)	(174.83)	(276.59)	(400.19)	(545.55)	(628.26)
50	(148.28)	(178.16)	(210.03)	(200.13)	0.00			(153.32)	(213.26)	(313.87)	(363.88)	0.00	
60	(176.26)	(163.94)	0.00					(173.98)	(193.91)	0.00			

Tax Values

The tables in this section include cash value accumulation test and guideline level and guideline single premiums (Section 7702), as well as 7-pay premiums (Section 7702A). The product tested is a variable universal life insurance product with permanent coverage. All calculations are made using the ultimate basis, unismoke table structure, age nearest birthday.

Cash value accumulation test	2001 CSO Unismoke ANB 4% interest
	2017 CSO Unismoke ANB 4% interest

Guideline single premium (7702)	2001 CSO Unismoke ANB 6% interest
	2017 CSO Unismoke ANB 6% interest

Guideline level premium (7702) and 7-pay premium (7702A)	2001 CSO Unismoke ANB 4% interest
	2017 CSO Unismoke ANB 4% interest

Because the calculations use the unismoke (1-class) table, guideline premium results between any two risk classes within a given gender class will show only minor variations. Any variation in the guideline premium factors is due to product-specific differences in policy charges and loads.

	Cash Value Accumulation Test			
	Factor per \$1,000 of Insurance Amount			
	Ultimate Basis			
	2017 CSO Factor as Percentage of 2001 CSO Factor			
	Percentage Increase			
Attained Age	MN	MS	FN	FS
0	88%	88%	88%	88%
10	91%	91%	90%	90%
20	92%	92%	91%	91%
30	91%	91%	92%	92%
40	90%	90%	92%	92%
50	89%	89%	93%	93%
60	91%	91%	95%	95%
70	94%	94%	99%	99%
80	97%	97%	101%	101%
90	100%	100%	103%	103%
100	100%	100%	100%	100%
110	100%	100%	100%	100%
120	100%	100%	100%	100%

7702 & 7702A Premiums									
2017 CSO Factor as Percentage of 2001 CSO Factor									
Ultimate Basis 1-Class									
Issue Age	Male Super Preferred Nonsmoker			Male Preferred Nonsmoker			Male Standard Nonsmoker		
	GSP	GLP	7-Pay	GSP	GLP	7-Pay	GSP	GLP	7-Pay
20	93%	92%	91%	93%	92%	91%	93%	92%	91%
25	92%	91%	91%	92%	91%	91%	92%	91%	91%
30	91%	90%	91%	91%	90%	91%	91%	90%	91%
35	90%	90%	91%	90%	90%	91%	90%	90%	91%
40	89%	88%	90%	89%	88%	90%	89%	88%	90%
45	87%	86%	89%	87%	86%	89%	87%	86%	89%
50	86%	85%	89%	86%	85%	89%	87%	85%	89%
55	87%	84%	89%	87%	85%	89%	87%	85%	89%
60	88%	84%	89%	88%	84%	89%	88%	84%	89%
65	89%	84%	90%	89%	84%	90%	89%	84%	90%
70	91%	85%	91%	91%	85%	91%	91%	85%	91%
75	93%	85%	91%	93%	85%	91%	93%	85%	91%
80	95%	86%	90%	95%	86%	90%	95%	86%	90%
85	NA	NA	NA	97%	89%	91%	97%	89%	91%

7702 & 7702A Premiums									
2017 CSO Factor as Percentage of 2001 CSO Factor									
Ultimate Basis 1-Class									
Issue Age	Female Super Preferred Nonsmoker			Female Preferred Nonsmoker			Female Standard Nonsmoker		
	GSP	GLP	7-Pay	GSP	GLP	7-Pay	GSP	GLP	7-Pay
20	90%	91%	90%	90%	91%	90%	90%	91%	90%
25	89%	91%	91%	90%	91%	91%	90%	91%	91%
30	89%	91%	91%	89%	91%	91%	89%	91%	91%
35	89%	91%	91%	89%	91%	91%	89%	91%	91%
40	89%	90%	91%	89%	91%	91%	89%	91%	91%
45	89%	90%	91%	89%	90%	91%	89%	90%	91%
50	89%	90%	92%	90%	90%	92%	90%	90%	92%
55	91%	91%	93%	91%	91%	93%	91%	91%	93%
60	93%	92%	94%	93%	92%	94%	93%	92%	94%
65	95%	94%	95%	95%	94%	95%	95%	94%	95%
70	97%	95%	97%	97%	95%	97%	97%	95%	97%
75	98%	97%	98%	98%	97%	98%	98%	97%	98%
80	100%	100%	99%	100%	100%	99%	100%	100%	99%
85	NA	NA	NA	101%	104%	101%	101%	104%	101%

7702 & 7702A Premiums 2017 CSO Factor as Percentage of 2001 CSO Factor Ultimate Basis 1-Class						
	Male Preferred Smoker			Male Standard Smoker		
Issue Age	GSP	GLP	7-Pay	GSP	GLP	7-Pay
20	94%	93%	91%	94%	93%	91%
25	93%	92%	91%	93%	92%	91%
30	92%	91%	91%	93%	92%	91%
35	91%	90%	91%	92%	91%	91%
40	89%	89%	90%	91%	90%	90%
45	87%	87%	89%	89%	88%	89%
50	87%	86%	89%	88%	86%	89%
55	87%	85%	89%	88%	85%	89%
60	88%	84%	89%	88%	85%	89%
65	89%	84%	90%	90%	85%	90%
70	91%	85%	91%	91%	85%	91%
75	93%	85%	91%	93%	85%	91%
80	95%	86%	90%	95%	86%	90%
85	97%	89%	91%	97%	89%	91%

7702 & 7702A Premiums 2017 CSO Factor as Percentage of 2001 CSO Factor Ultimate Basis 1-Class						
	Female Preferred Smoker			Female Standard Smoker		
Issue Age	GSP	GLP	7-Pay	GSP	GLP	7-Pay
20	91%	92%	90%	91%	92%	90%
25	90%	92%	91%	91%	92%	91%
30	90%	92%	91%	91%	92%	91%
35	90%	91%	91%	90%	91%	91%
40	90%	91%	91%	90%	91%	91%
45	89%	90%	91%	89%	90%	91%
50	90%	90%	92%	90%	90%	92%
55	91%	91%	93%	91%	91%	93%
60	93%	92%	94%	93%	92%	94%
65	95%	94%	95%	95%	94%	95%
70	97%	95%	97%	97%	95%	97%
75	98%	97%	98%	98%	97%	98%
80	100%	100%	99%	100%	100%	99%
85	101%	104%	101%	101%	104%	101%

Aggregate Analysis Overview

The aggregate data provided by participating companies consisted of the aggregate formulaic reserves (NPR or CRVM method, depending on product type) and the modeled VM-20 DR for a one-issue-year cohort of business. Distribution of the policies within the cohort by issue age, issue month, risk class, gender and underwriting class follow company experience. Assumptions used in the DR follow the company's prudent estimate experience, as required by VM-20. The values shown are forecasted amounts determined either by using an inner/outer loop processing function, or by aging the one-issue-year cohort and valuing each older cohort at the same valuation date. An inner/outer loop processing function will roll the policy population forward using anticipated experience assumptions, but calculate the DR at each future period according to prudent estimate assumptions. The objective of the aggregate data collection is to provide a comparison of the DR and NPR for purposes of assessing calibration, i.e., the relationship of these two amounts to each other.

Each company participating in this portion of the research has performed VM-20 calculations according to its own interpretation of those requirements. Beyond specifying the beta testing mortality tables to use, Milliman did not dictate any assumptions or methods for this portion of the analysis.

Whole Life Product

One company submitted aggregate results for 20 years showing the CRVM reserves on both 2001 and 2017 CSO mortality tables, and the DR using both the 2008 VBT and, alternatively, the 2014 VBT. Because experience is 90 to 100 percent credible during this period with a 13- to 18-year sufficient data period, there are only small differences between the DR (2008) and DR (2014). The relationship emerging during the first 20 years finds the NPR exceeds the DR initially, and then drops below the DR beginning in year 7. The DR may be artificially high due to the company's inclusion of term conversion risks in the experience study. Values beyond year 20 were not provided.

20-Year Term Product

Seven companies submitted aggregate results for the Term product. One of these companies used a methodology for forecasting the DR that it deemed too simplistic to fulfill the data request. Results for this company (Company 3) were omitted from the aggregate analysis.

Two companies (Company 1 and Company 7) provided XXX method reserves and these results are included in the graphs, but not commented on in this analysis. The following characteristics are evident from the submitted data.

- The floor to the NPR, which is the greater of the policy cash value (\$0 for this Term product) and the remaining cost of insurance, is typically the driver in the early policy years and in the final policy years of the level premium period. This characteristic will not be evident in graphs of companies that chose not to apply the NPR floor (Companies 6 and 7).
- NPR calculated using 2001 CSO produces a pattern of reserves that grow to exceed the DR around the middle of the level premium period.
- NPR calculated using 2017 CSO produces a pattern of reserves that grow to an amount less than the DR around the middle of the level premium period. Exceptions to this finding are:
 - Company 5's later durations of NPR and DR are very close in both magnitude and pattern.

- Company 7's DR falls below the NPR calculated on 2017 CSO because, in that company's review, the combination of company mortality experience and relatively high gross premiums provides for a DR less than the NPR in nearly all durations.
- In submissions where the company tested the DR on both the 2008 VBT and the 2014 VBT, DR(2014) produced a reserve pattern in excess of DR(2008) in some durations, lower in others. Reasons for this relationship may stem from the process used to recalibrate the company's expected basis in its mortality study. For example, an actual-to-expected ratio using the 2014 VBT as "expected" would produce a higher ratio than would otherwise emerge if using the 2008 VBT as "expected." If this condition occurs for portions of the modeled population with the greatest amount of in-force, it may have a greater impact than one would expect. Or, if the company did not recalibrate its mapping to the 2014 VBT Relative Risk tables using the updated UCS tool, and simply used the mapping derived from an older UCS, this too could skew the results in an unexpected way.
- For companies enjoying the highest levels of credibility, the Bühlmann credibility method and proposed margins produce a DR slightly lower than that produced by the limited-fluctuation credibility method and proposed margins.

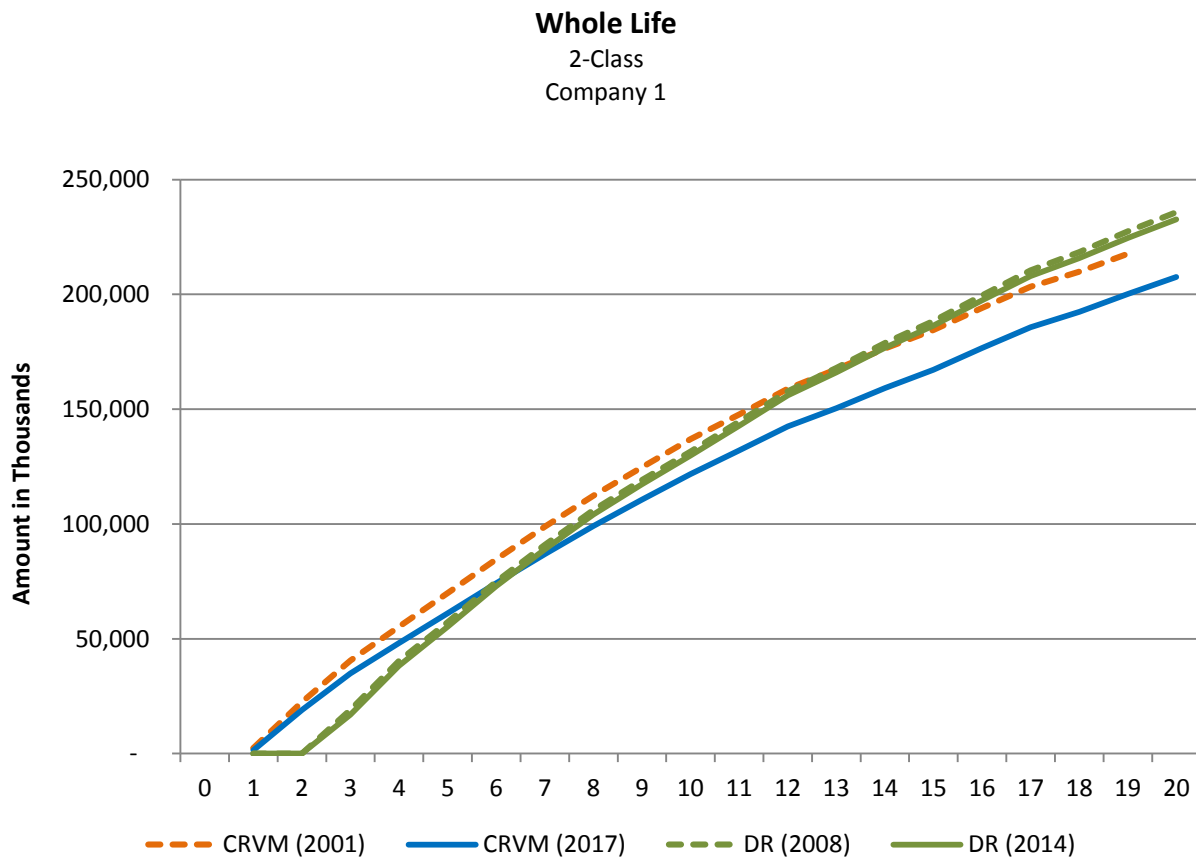
ULSG Product

Three companies submitted aggregate results for the ULSG product. The following characteristics are evident from the submitted data.

- The DR produces a level and pattern of reserve that exceed the NPR.
- The NPR (2017) is less than the NPR (2001).
- In submissions where the company tested the DR on both the 2008 VBT and the 2014 VBT, DR (2014) produced a reserve pattern in excess of DR (2008) in some durations, lower in others. See the Term section above for a discussion on probable causes for this outcome.
- For companies enjoying the highest levels of credibility, the Bühlmann credibility method and proposed margins produce a DR slightly lower than that produced by the limited-fluctuation credibility method and proposed margins.

Aggregate Analysis—Whole Life Product

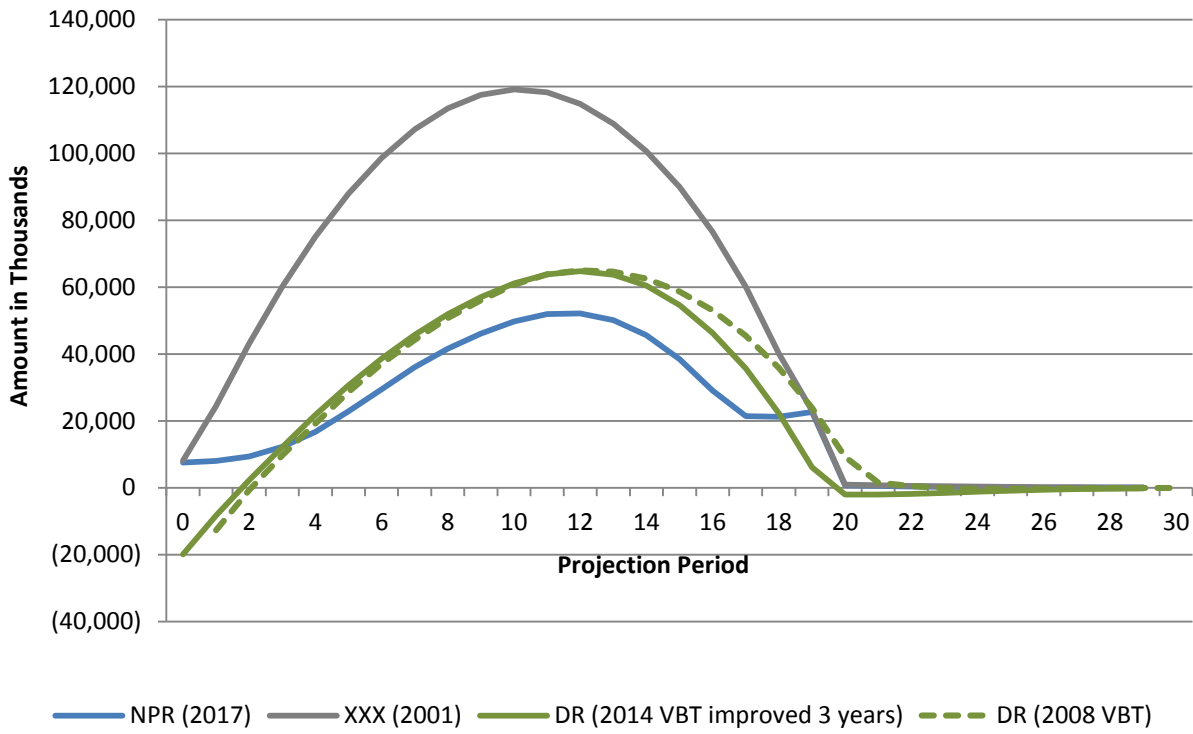
Whole Life Company	Mortality Credibility; Relevant Notes	Forecast Method
1	<p>90-100% credibility on limited fluctuation for all risk classes</p> <p>Sufficient data period 13-18 years depending on class</p> <p>DR was forecast for 20 years.</p>	Aging one issue year



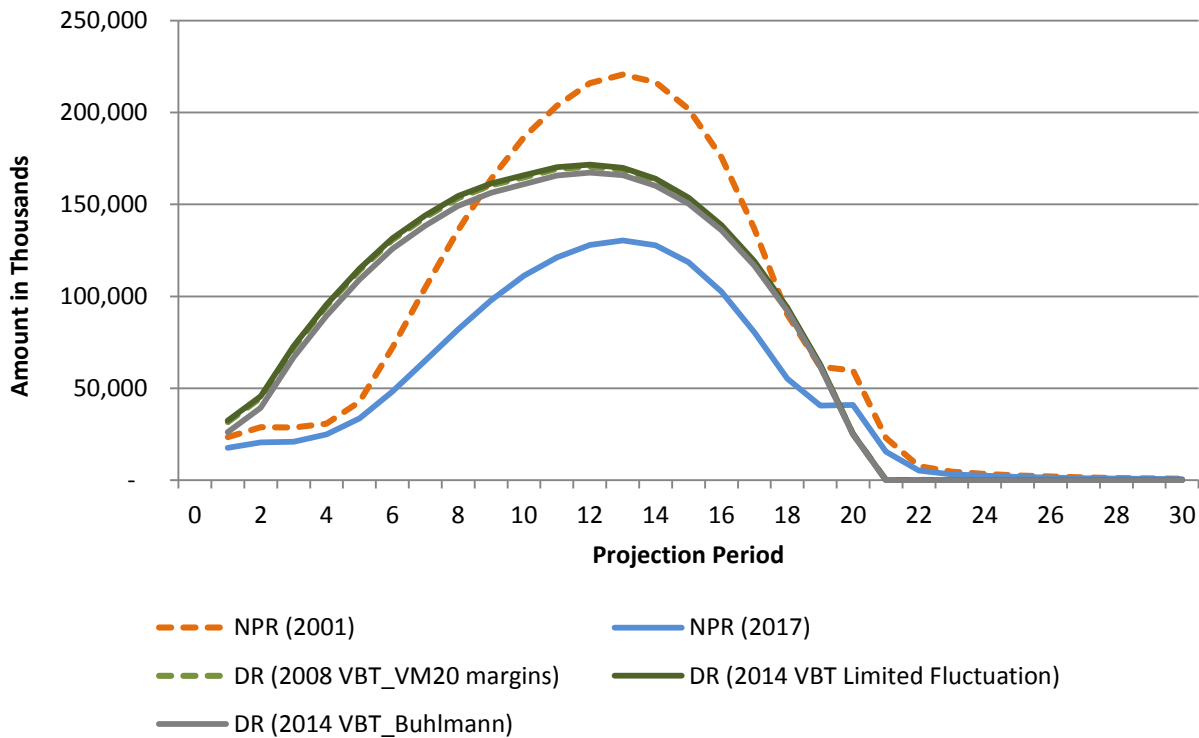
Aggregate Analysis—20-Year Term Product

Term Company	Mortality Credibility; Relevant Notes	Forecast Method	Post-LTP
1	90–100% credibility on limited fluctuation (NS) Much less credibility for smoker class	Aging one issue year	98% shock
2	90–100% credibility on limited fluctuation 99–100% credibility on Bühlmann 1% improvement up to each future valuation node, not beyond node	Inner/outer loop with mortality improvement up to valuation date	100% shock
3	Too simplified to include		
4	90–100% limited fluctuation (NS) < 100% credible (smokers); industry table used only for smoker risks	Aging one issue year	90+% shock
5	90–100% limited fluctuation	Inner/outer loop	Unknown
6	90–100% limited fluctuation No floors applied to NPR for this analysis DR(time 0) includes cost of acquisition DR(2008) uses VM-20 margins DR(2014) uses proposed margins	Inner/outer loop	70% shock
7	90–100% limited fluctuation No industry mortality used The combination of company mortality and other prudent estimate assumptions provides for a DR less than the NPR in nearly all durations. For this analysis, no floor was applied to the NPR.	Inner/outer loop	100% shock

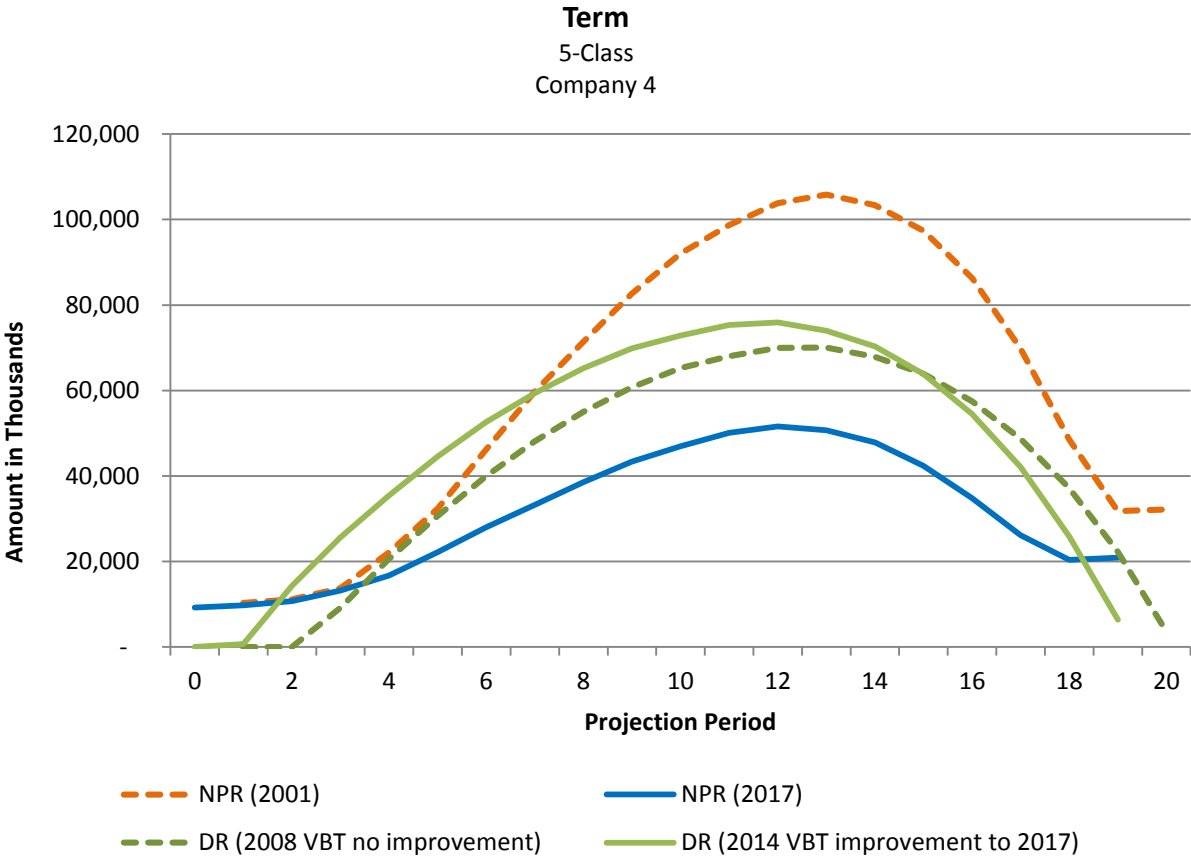
Term
5-Class
Company 1



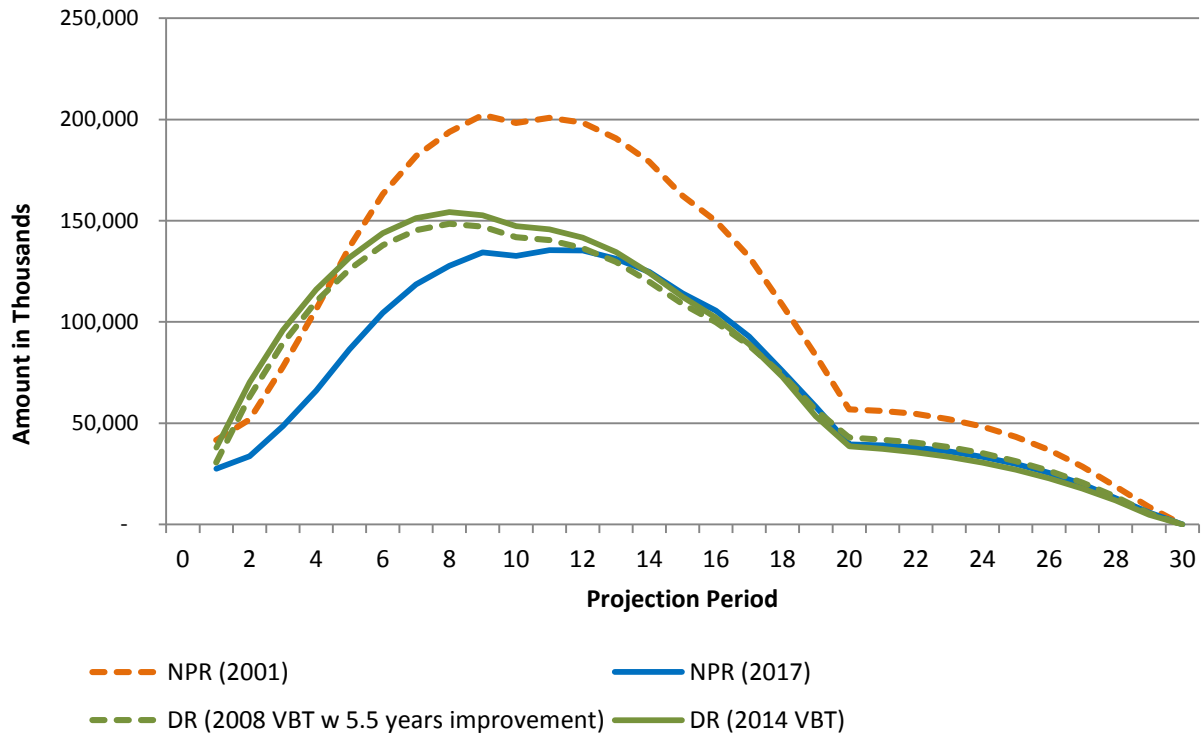
Term
5-Class
Company 2



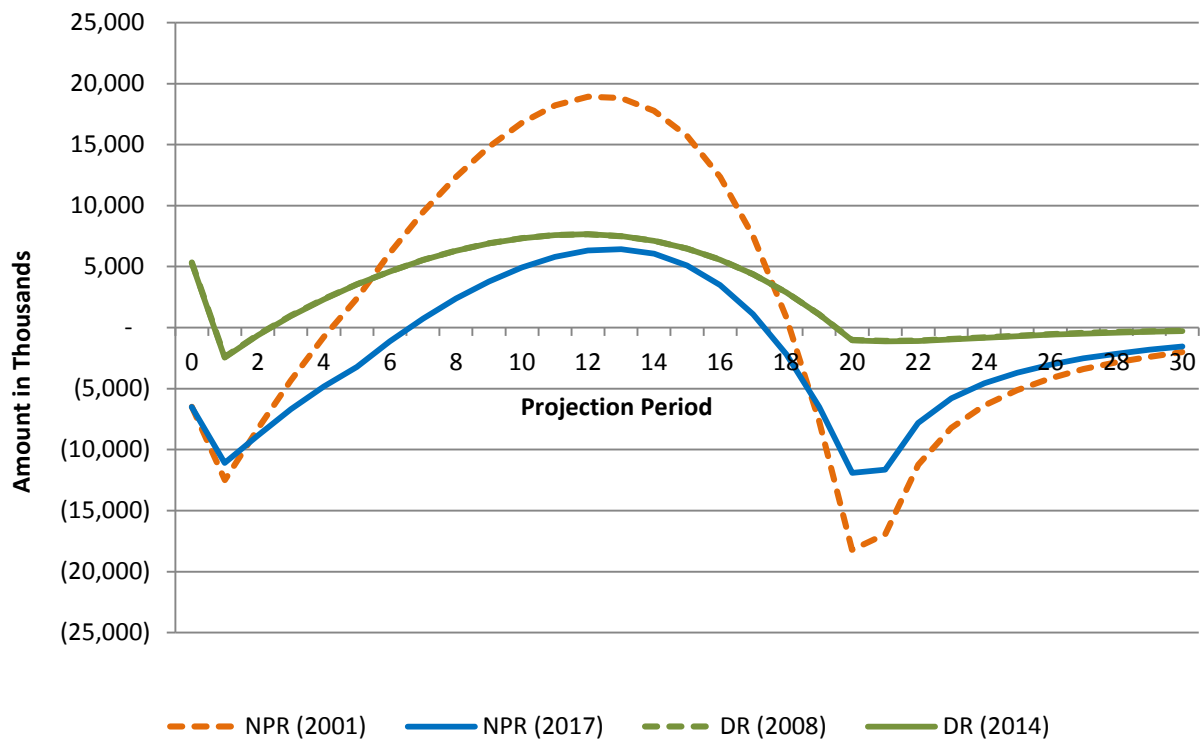
Company 3
(Deemed too simplified for inclusion)



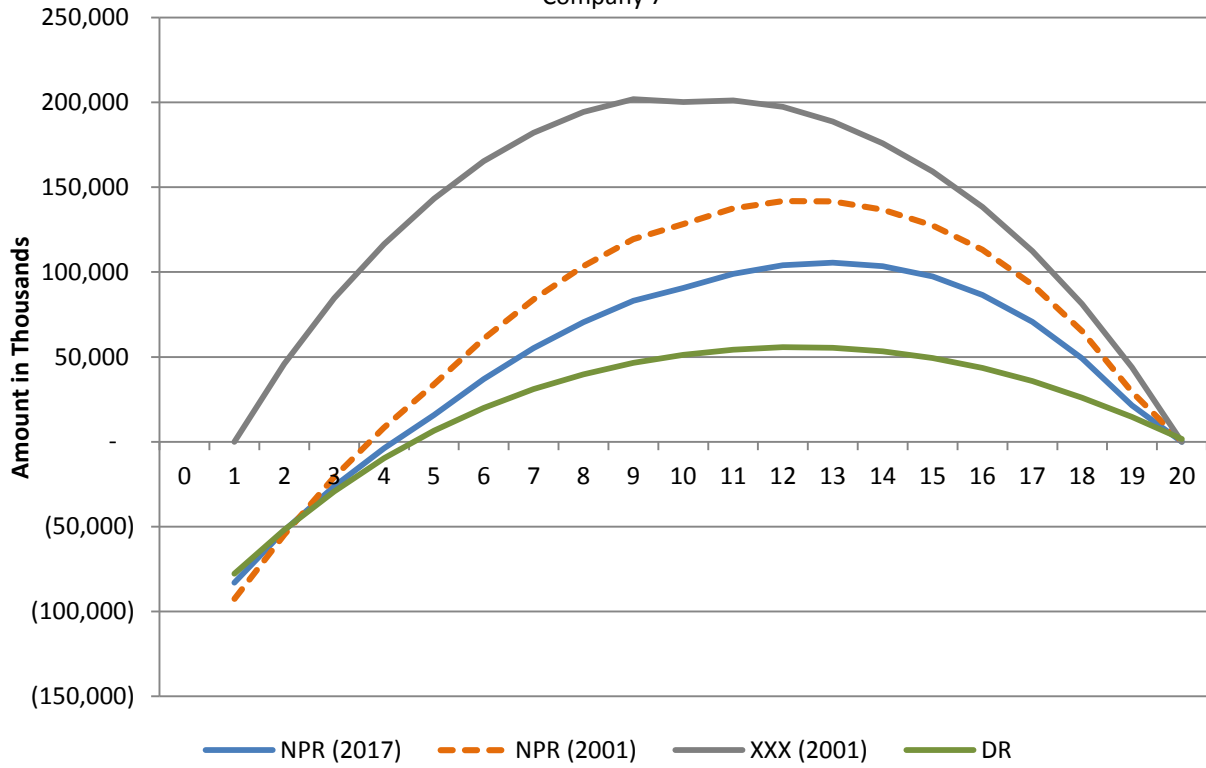
Term
5-Class
Company 5



Term
2-Class
Company 6



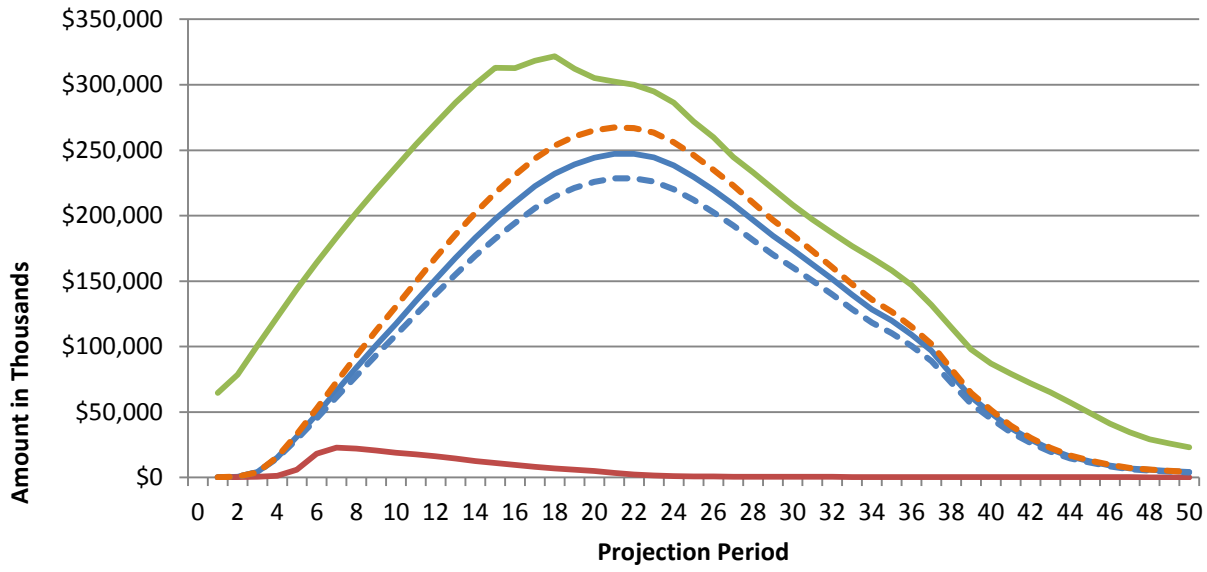
Term
5-Class
Company 7



Aggregate Analysis—ULSG Product

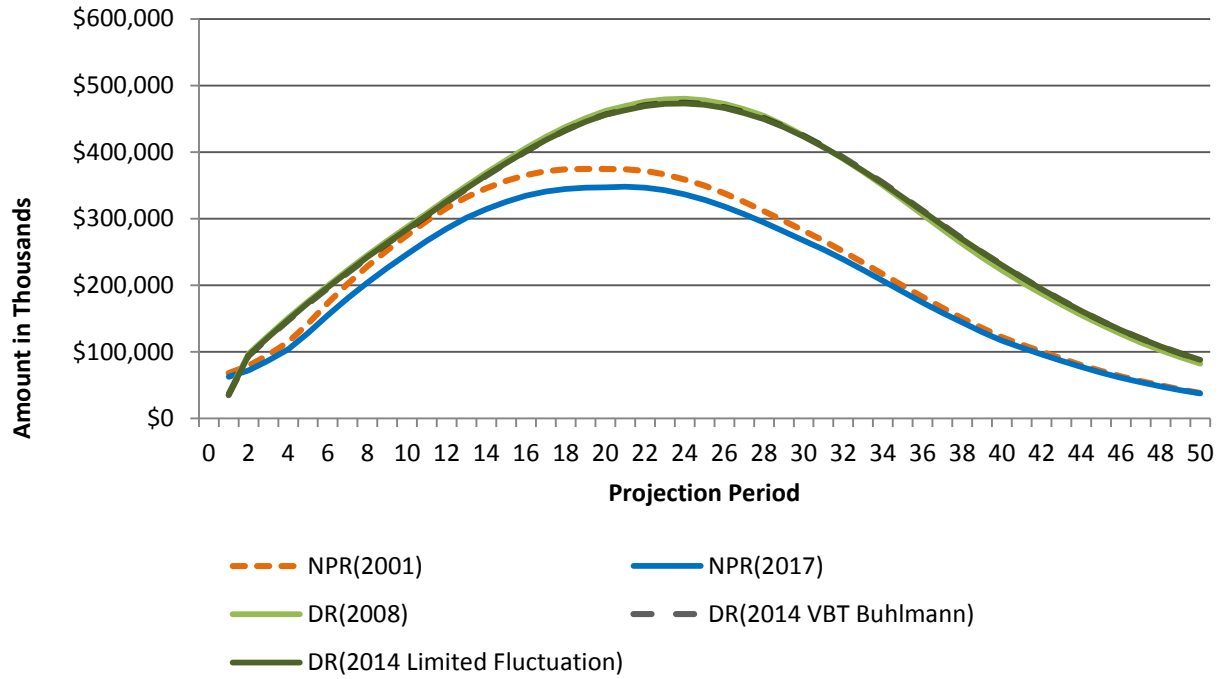
ULSG Company	Mortality Credibility; Relevant Notes	Forecast Method	Industry Basis
1	90-100% limited fluctuation No-lapse guarantee design is a shadow account to maximum attained age 95	Inner/outer loop	2014 VBT Improved to 2017
2	90-100% limited fluctuation 99%+ under Bühlmann	VM-20 assumptions used for aging population and for valuation at future nodes	2008 or 2014 VBT no improvement
3	90-100% limited fluctuation Multi-shadow account no-lapse guarantee design Minimum cash values	Inner/outer loop	2008 VBT improved 5.5 years 2014 VBT no improvement

**ULSG
5-Class
Company 1**

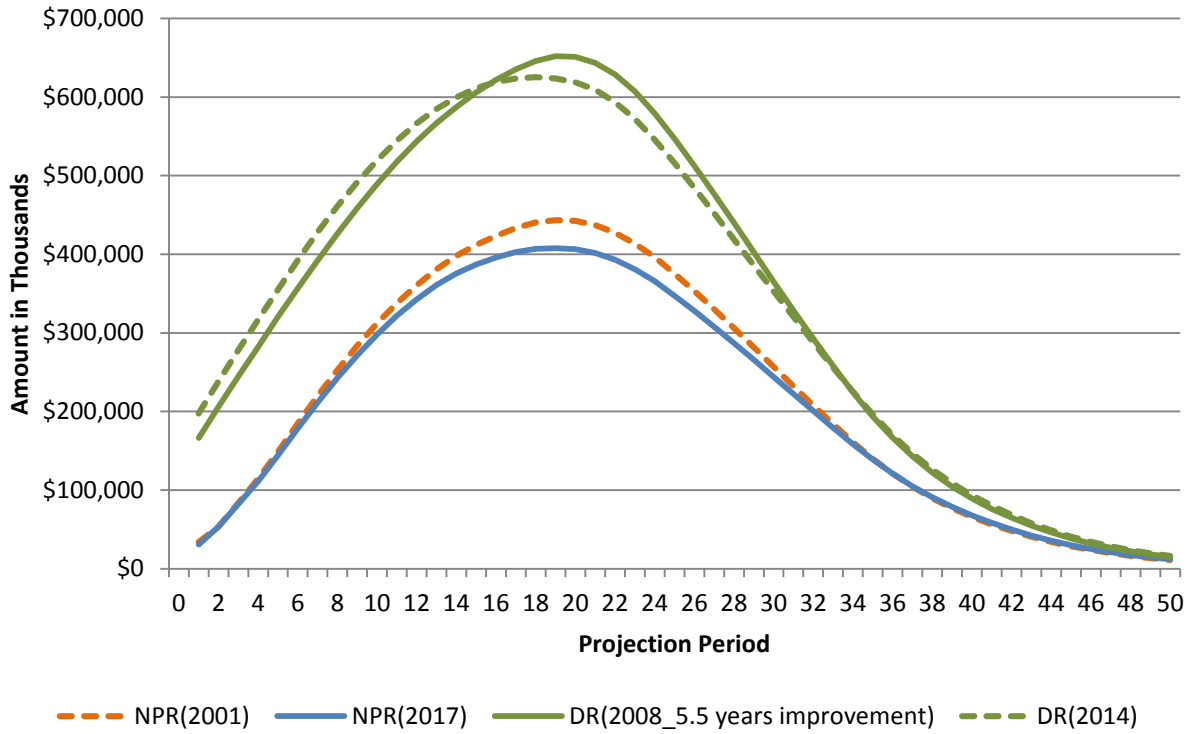


- NPR (2017)
- CSV floor
- DR (2014 VBT, Limited Fluctuation)
- - - NPR (unloaded 2017)
- - - NPR (2001)

**ULSG
2-Class
Company 2**



ULSG
5-Class
Company 3



Appendix A—Model Office Definition

WHOLE LIFE						
Gender	Smoking Class	Issue Age		Super Preferred	Preferred	Residual
			2-Class	5-Class		
M	Nonsmoker	25	7.88%	2.61%	7.88%	4.27%
M	Nonsmoker	35	9.59%	3.18%	9.59%	5.19%
M	Nonsmoker	45	8.48%	2.81%	8.48%	4.59%
M	Nonsmoker	55	6.21%	2.06%	6.21%	3.36%
M	Nonsmoker	65	4.39%	1.45%	4.39%	2.38%
M	Nonsmoker	75	1.88%	0.62%	1.88%	1.02%
F	Nonsmoker	25	10.57%	3.50%	10.57%	5.73%
F	Nonsmoker	35	12.86%	4.26%	12.86%	6.97%
F	Nonsmoker	45	11.37%	3.77%	11.37%	6.16%
F	Nonsmoker	55	8.32%	2.76%	8.32%	4.51%
F	Nonsmoker	65	5.89%	1.95%	5.89%	3.19%
F	Nonsmoker	75	2.52%	0.83%	2.52%	1.36%
M	Smoker	25	0.88%		0.88%	0.51%
M	Smoker	35	1.07%		1.07%	0.62%
M	Smoker	45	0.95%		0.95%	0.55%
M	Smoker	55	0.69%		0.69%	0.40%
M	Smoker	65	0.49%		0.49%	0.29%
M	Smoker	75	0.21%		0.21%	0.12%
F	Smoker	25	1.18%		1.18%	0.69%
F	Smoker	35	1.44%		1.44%	0.84%
F	Smoker	45	1.27%		1.27%	0.74%
F	Smoker	55	0.93%		0.93%	0.54%
F	Smoker	65	0.66%		0.66%	0.38%
F	Smoker	75	0.28%		0.28%	0.16%
		Total	100.00%	29.80%	15.61%	54.59%
M	Unismoke	25	8.76%			
M	Unismoke	35	10.66%			
M	Unismoke	45	9.42%			
M	Unismoke	55	6.90%			
M	Unismoke	65	4.88%			
M	Unismoke	75	2.08%			
F	Unismoke	25	11.75%			
F	Unismoke	35	14.30%			
F	Unismoke	45	12.64%			
F	Unismoke	55	9.25%			
F	Unismoke	65	6.54%			
F	Unismoke	75	2.80%			
		Total	100.00%			

TERM						
Gender	Smoking Class	Issue Age		Super Preferred	Preferred	Residual
			2-Class	5-Class		
M	Nonsmoker	25	8.68%	4.03%	2.03%	2.62%
M	Nonsmoker	35	16.96%	7.88%	3.97%	5.11%
M	Nonsmoker	45	16.11%	7.48%	3.77%	4.85%
M	Nonsmoker	55	8.69%	4.04%	2.03%	2.62%
M	Nonsmoker	65	2.90%	1.35%	0.68%	0.87%
F	Nonsmoker	25	6.88%	3.20%	1.61%	2.07%
F	Nonsmoker	35	13.44%	6.24%	3.15%	4.05%
F	Nonsmoker	45	12.77%	5.93%	2.99%	3.85%
F	Nonsmoker	55	6.89%	3.20%	1.61%	2.08%
F	Nonsmoker	65	2.30%	1.07%	0.54%	0.69%
M	Smoker	25	0.40%		0.18%	0.22%
M	Smoker	35	0.78%		0.35%	0.43%
M	Smoker	45	0.74%		0.33%	0.41%
M	Smoker	55	0.40%		0.18%	0.22%
M	Smoker	65	0.13%		0.06%	0.07%
F	Smoker	25	0.32%		0.14%	0.18%
F	Smoker	35	0.62%		0.27%	0.34%
F	Smoker	45	0.59%		0.26%	0.33%
F	Smoker	55	0.32%		0.14%	0.18%
F	Smoker	65	0.11%		0.05%	0.06%
		Total	100.00%	44.42%	24.32%	31.26%
M	Unismoke	25	9.08%			
M	Unismoke	35	17.74%			
M	Unismoke	45	16.85%			
M	Unismoke	55	9.09%			
M	Unismoke	65	3.03%			
F	Unismoke	25	7.19%			
F	Unismoke	35	14.06%			
F	Unismoke	45	13.35%			
F	Unismoke	55	7.20%			
F	Unismoke	65	2.40%			
		Total	100.00%			

ULSG						
Gender	Smoking Class	Issue Age		Super Preferred	Preferred	Residual
			2-Class	5-Class		
M	NSM	25	3.98%	1.53%	1.09%	1.36%
M	NSM	35	8.94%	3.44%	2.44%	3.06%
M	NSM	45	11.53%	4.44%	3.15%	3.95%
M	NSM	55	10.51%	4.04%	2.87%	3.60%
M	NSM	65	7.79%	3.00%	2.13%	2.66%
M	NSM	75	2.15%	0.83%	0.59%	0.74%
F	NSM	25	4.52%	1.74%	1.23%	1.55%
F	NSM	35	10.16%	3.91%	2.77%	3.47%
F	NSM	45	13.10%	5.04%	3.58%	4.48%
F	NSM	55	11.94%	4.59%	3.26%	4.09%
F	NSM	65	8.85%	3.40%	2.42%	3.03%
F	NSM	75	2.44%	0.94%	0.67%	0.84%
M	Smoker	25	0.17%		0.06%	0.11%
M	Smoker	35	0.38%		0.14%	0.24%
M	Smoker	45	0.49%		0.19%	0.31%
M	Smoker	55	0.45%		0.17%	0.28%
M	Smoker	65	0.33%		0.13%	0.21%
M	Smoker	75	0.09%		0.03%	0.06%
F	Smoker	25	0.19%		0.07%	0.12%
F	Smoker	35	0.43%		0.16%	0.27%
F	Smoker	45	0.56%		0.21%	0.35%
F	Smoker	55	0.51%		0.19%	0.32%
F	Smoker	65	0.38%		0.14%	0.23%
F	Smoker	75	0.10%		0.04%	0.06%
		Total	100.00%	36.90%	27.74%	35.36%
M	Unismoke	25	4.15%			
M	Unismoke	35	9.32%			
M	Unismoke	45	12.03%			
M	Unismoke	55	10.96%			
M	Unismoke	65	8.12%			
M	Unismoke	75	2.24%			
F	Unismoke	25	4.71%			
F	Unismoke	35	10.59%			
F	Unismoke	45	13.66%			
F	Unismoke	55	12.45%			
F	Unismoke	65	9.22%			
F	Unismoke	75	2.55%			
		Total	100.00%			