Life Actuarial (A) Task Force
Amendment Proposal Form*

1. Identify yourself, your affiliation and a very brief description (title) of the issue.

   Dave Neve, chairperson of the American Academy of Actuaries Life Reserves Work Group.

2. Identify the document, including the date if the document is "released for comment," and the location in the document where the amendment is proposed: VM-20:

   Requirements for Principle-based Reserves for Life Products, Draft dated 12/2/12, Section 4

3. Show what changes are needed by providing a red-line version of the original verbiage with deletions and identify the verbiage to be deleted, inserted or changed by providing a red-line (turn on "track changes" in Word®) version of the verbiage. (You may do this through an attachment.)

   See Appendix A.

4. State the reason for the proposed amendment:

   Summary of Proposal

   Under this amendment, a company would have the option to calculate the Deterministic Reserve ("DR") using an alternative method to the one already specified in VM-20. The alternative method theoretically results in equivalent reserves as those produced under the current VM-20 approach.

   The alternative method ("Direct Iteration Option") permits the calculation of the DR by finding directly the starting assets that fully liquidate the liabilities for a block of business over the DR projection horizon using the same cash flow model and assumptions required currently in VM-20. The statutory carrying value of those starting assets is held as the DR. This alternative mitigates certain issues associated with the current VM-20 approach while simplifying the calculation of the DR (including eliminating the need to calculate Net Asset Earned Rates ("NAERs")).

Appendix A

Section 4. Deterministic Reserve

For a group of one or more policies for which a deterministic reserve must be calculated pursuant to Sections 2.A or 2.B, the company shall calculate the deterministic reserve for the group using the method described in either subsection A or subsection B of this section. If the company elects to calculate the deterministic reserve under the method described in subsection A, then the company must provide a demonstration that the resulting deterministic reserve would not be less than the deterministic reserve if calculated under the method described in subsection B.

A. Calculate the deterministic reserve equal to the actuarial present value of benefits, expenses, and related amounts less the actuarial present value of premiums and related amounts where:

1. Cash flows are projected in compliance with the applicable requirements in Sections 7, 8 and 9 over the single economic scenario described in Section 7.G.1.

2. Present values are calculated using the path of discount rates for the corresponding model segment determined in compliance with Section 7.H.4.

3 The actuarial present value of benefits, expenses and related amount equals the sum of:

a. Present value of future benefits, but before netting the repayment of any policy loans;

Guidance Note: Future benefits include but are not limited to death and cash surrender benefits.

b. Present value of future expenses excluding federal income taxes and expenses paid to provide fraternal benefits in lieu of federal income taxes;

b. Policy account value invested in the separate account at the valuation date; and

Guidance Note: when paragraph c. is taken in conjunction with 4.b. below, the net result produces the correct cash flows as well as NAER,

c. Policy loan balance at the valuation date with appropriate reflection of any relevant due, accrued or unearned loan interest, if policy loans are explicitly modeled under Section 7.E.

d. Policy loan balance at the valuation date with appropriate reflection of any relevant due, accrued or unearned loan interest, if policy loans are explicitly modeled under Section 7.E.

Guidance Note: when paragraph d. is taken in conjunction with 4.c. below, the net result produces the correct cash flows as well as NAER,

4. The actuarial present value of premiums and related amounts equals the sum of the present values of

a. Future gross premium payments and/or other applicable revenue;

b. Future net cash flows to or from the general account, or from or to the separate account;

c. Future net policy loan cash flows, if policy loans are explicitly modeled under Section 7.E; **Guidance Note:** Future net policy loan cash flows include: loan interest paid in cash; additional loan principal; and repayments of principal, including repayments occurring at death or surrender (note that the future benefits in Section 4.A.3.a are before consideration of policy loans).

d. Future net reinsurance discrete cash flows determined in compliance with Section 8;

e. The future net reinsurance aggregate cash flows allocated to this group of policies as described in Subsection C of this section; and

f. The future derivative liability program net cash flows (i.e., cash received minus cash paid) that are allocated to this group of policies.

5. If a group of policies is excluded from the stochastic reserve requirements, the company may not include future transactions associated with non-hedging derivative programs in determining the deterministic reserve for those policies.

B. Calculate the deterministic reserve as a - b, where

a = the aggregate annual statement value of those starting assets which, when projected along with all premium and investment income, result in the liquidation of all projected future benefits and expenses by the end of the projection horizon. Under this alternative, the following considerations apply:

1. Cash flows are projected in compliance with the applicable requirements in Section 7, 8 and 9 over the single scenario described in Section 7.G.1.

2. The requirements for future benefits and premiums in Section 4.A apply as well to the calculation of the deterministic reserve under this subsection.

b = that portion of the PIMR amount allocated under Section 7.

C. Future net reinsurance aggregate cash flows shall be allocated as follows:

1. Future net reinsurance aggregate cash flows shall be allocated to each policy reinsured under a given reinsurance agreement in the same proportion as the ratio of each policy's present value of future net reinsurance discrete cash flows to total present value of future net reinsurance discrete cash flows under the reinsurance agreement.

2. Future net reinsurance aggregate cash flows allocated to a group of policies is equal to the sum of future net reinsurance aggregate cash flows allocated to each policy in the group.

Direct Iteration vs Gross Premium Valuation (PV Cash Flows) for Deterministic Reserves

American Academy of Actuaries[1]
Life Financial Soundness/Risk Management Committee

Presented to the National Association of Insurance Commissioners' Life Actuarial Task Force

December 13, 2013

This exercise is intended to demonstrate an answer to the question: "Does the Direct Iteration approach for the deterministic reserve result in the same amount as the Gross Premium Valuation approach currently required by VM-20?"

The Direct Iteration approach defines the reserve to equal the amount of starting assets that produces an accumulated asset value of zero at the end of the projection period.

The Gross Premium Valuation approach (PV (Cash Flows) or PV(CF)) defines the reserve to equal the present value of future cash flows using net asset earned rates as the discount rates.

A modeling software platform from a vendor was used to perform the cash flow projections, which are summarized in the attached Excel spreadsheet. What follows is an explanation of what is contained in each tab of the spreadsheet.

A. PV(Cash flows) tab

Cash flows emanating from an inforce model of 206 contracts (these happen to be deferred annuity contracts, but the underlying source of cash flows does not matter to the demonstration).

a. Cash Income = Premium
b. Cash Outgo = Surrender payments; Death claim payments; Expenses
c. Rate for Discount: An average cycle net investment earnings rate, which is determined by the modeling system and extracted for use in the spreadsheet. The modeling system follows the general formula $(1+A/B)^{12}-1$ when determining this variable where:

A includes monthly interest on cash, monthly interest income (coupons, etc), monthly change in accrued investment income, monthly accrual of discount or premium, monthly default costs, monthly investment expense, and

[1] The American Academy of Actuaries is a 17,500-member professional association whose mission is to serve the public and the U.S. actuarial profession. The Academy assists public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

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B is the invested asset earnings base, or (Cash + Invested Assets) for the month. Note that the pre-tax IMR (PIMR) is omitted for simplicity.

Items a, b, and c above are used to develop the PV(CashFlows) as follows:

- Cash Income, or Premium, is discounted using a monthly discount rate, from the *beginning* of the month.
- Surrender payments are discounted using a monthly discount rate, from the *end* of the month
- Death claim payments and expenses are discounted using a monthly discount rate, from the *middle* of the month.

At the 823rd month, all fractional portions of the policies have expired. The end result of discounting the monthly cash flows over 823 months is $1,558,929.40. To be clear, then starting assets used for this projection are within the 2% collar required by VM-20.

B. Direct Iteration Tab

Balance sheet showing total assets, total liabilities and free surplus from the projection whereby starting assets (Assets(0) in chart) are equal to the baseline amount of $1,550,205. Two other trials were also performed, each $1 apart from the baseline. The total assets at month 823, when liabilities are extinguished, is positive and near zero with a starting asset value of $1,550,205. The table below shows the sensitivity in month t=823 to a +$1 and -$1 variance in starting assets. The variance between the direct iteration starting asset number of $1,550,205 and the PV(CF) number of $1,558,929.40 is $8,724 or 0.56% of the starting asset amount.

			Assets(month)			
	Assets(0)	PV(CF)	t=400	t=600	t=800	t=823
i	1,550,204	1,558,929.50	82,313	1,943	1.79	1.74
Ii	1,550,205	1,558,929.40	82,316	1,948	12.50	13.21
iii	1,550,206	1,558,929.32	82,319	1,954	23.08	24.58

C. Graph Tab

Assets by projection month. This tab was included simply to show that the asset values remain positive throughout the course of the projection.

Characteristics that allow the Direct Iteration result to converge to the PV(CF) result:

1. Increased granularity in the determination of the discount rate. A monthly projection cycle, rather than annual for example. This provides an "average cycle net investment earnings rate" that is as consistent as possible with the investment earnings rate implied by the cash account and invested asset cash flows.

2. Increased granularity in the cash flows used. Requiring the system to provide monthly cash flows allows for recognition of a more granular view to the timing of these monthly

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cash flows. Cash flows must be discounted using a discount rate that is consistent with their monthly timing in the model (begin, end, spread). So, if the modeling system treats expenses as being spread evenly over the month, then using a discount factor from the middle of the month increases the likelihood of convergence.

3. Keeping a positive asset amount throughout the projection.

4. This example does not consider policy loans or PIMR, but had these been included, convergence may have been more adversely impacted.

Direct Iteration vs PV (Cash Flows) on ANNUAL CYCLE BASIS

We also tested the convergence of the two approaches using an annual projection cycle. The only change made to the model setup is to move from a monthly projection cycle (whereby investments/disinvestments are performed monthly) to an annual projection cycle. The only change made to the *workbook* setup (i.e., the PV(CF) calculation) is to make the discount factors reflect the annual reporting cycle and to discount premium from mid-year, since the mode of payment is monthly. Detailed results from this projection are not attached, but are available.

The monthly chart is restated below, followed by the annual results, with discussion.

MONTHLY

			Assets(month)			
	Assets(0)	PV(CF)	t=400	t=600	t=800	t=823
i	1,550,204	1,558,929.50	82,313	1,943	1.79	1.74
ii	1,550,205	1,558,929.40	82,316	1,948	12.50	13.21
iii	1,550,206	1,558,929.32	82,319	1,954	23.08	24.58

ANNUAL

			Assets(year)			
	Assets(0)	PV(CF)	t=33	t=50	t=67	t=69
i	1,550,204	1,557,897.43	-46,954	-64,817	-65,099	-65,098.77
ii	1,550,205	1,557,898.12	-46,951	-64,814	-65,095	-65,095.48
iii	1,550,206	1,557,898.80	-46,948	-64,811	-65,092	-65,092.24
C	1,567,279	1,558,519.11	2,581	42	1	1

In the Annual table, rows i, ii, and iii are simply the starting asset amounts used in the monthly work, with corresponding PV(CF) results and projected asset values. The row labeled "C" is the convergence iteration on the annual cycle basis (*consider the row "C" as the parallel to the Monthly table, row i, both having ending asset values near zero*). The primary take-away from this particular model is that, when using granular discounting mechanics, as represented by the *monthly* cycle, the variance between Direct Iteration approach and PV(CF) approach is essentially the same as the parallel demonstration using an

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annual cycle. In other words, variance in the results of the two approaches under consideration is very similar as long as the same care is taken in reflecting the appropriate cash flow timing in the discounting process within the PV(CF) approach. Numerically, this observation is summarized below.

Projection cycle	Direct Iteration Starting Assets	PV(CF)	Difference	Difference as % of Direct Iteration Starting Assets
Monthly (row i)	$ 1,550,204	$ 1,558,929.50	$ 8,725.50	0.5629%
Annual (row C)	$ 1,567,279	$ 1,558,519.11	$ 8,759.89	0.5589%

Conclusion

This exercise is intended to demonstrate an answer to the question: “Does Direct Iteration approach result in the same amount as the Gross Premium Valuation approach currently required by VM-20?” Our conclusion is yes, assuming the PV(CF) is performed with a robust level of granularity, particularly in regard to the timing of cash flows during the cycle of the projection. This particular demonstration shows this to be true regardless of the projection interval used in modeling the cash flows.

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PV (Cash Flows)

CASH FLOW STATEMENT

			1 12/2012 to 01/2013	2 01/2013 to 02/2013	3 02/2013 to 03/2013	4 03/2013 to 04/2013	5 04/2013 to 05/2013	6 05/2013 to 06/2013
	CASH INCOME:							
X	**Cash premiums**		321.56	319.18	316.83	314.51	312.20	309.92
	Total liability cash income		321.56	319.18	316.83	314.51	312.20	309.92
	CASH OUTGO:							
X	**Surrender benefits**		6,684.57	6,655.26	6,626.20	6,597.38	6,568.80	6,540.45
X	**Partial withdrawals paid**		0.00	0.00	0.00	0.00	0.00	0.00
X	**Death claims**		4,784.95	4,731.59	4,679.15	4,627.60	4,576.94	4,527.12
X	**Maintenance expenses**		860.92	855.47	850.08	844.74	839.44	834.18
	Total liability cash outgo		12,330.43	12,242.33	12,155.43	12,069.72	11,985.17	11,901.75
	Average cycle net investment earnings rate *		0.03000	0.04086	0.04074	0.04061	0.04048	0.04035

CALC DISCOUNT RATE (BOM)	1.0000000	0.997540	0.994216	0.990913	0.987631	0.984371
CALC DISCOUNT RATE (EOM)	0.997540	0.994216	0.990913	0.987631	0.984371	0.981131
CALC DISCOUNT RATE (MID-MONTH)	0.998769	0.995877	0.992563	0.989271	0.986000	0.982749
Disc Neg CF less Pos CF	11,985	11,862	11,739	11,618	11,498	11,381

SUM **$ 1,558,929.40**

Starting Assets for this Iteration: **$ 1,550,205.00**

Collar: (Starting assets for run/PVCF) **99.4%** **Consistent with the 2% collar requirement.**

$ 8,724 0.56%

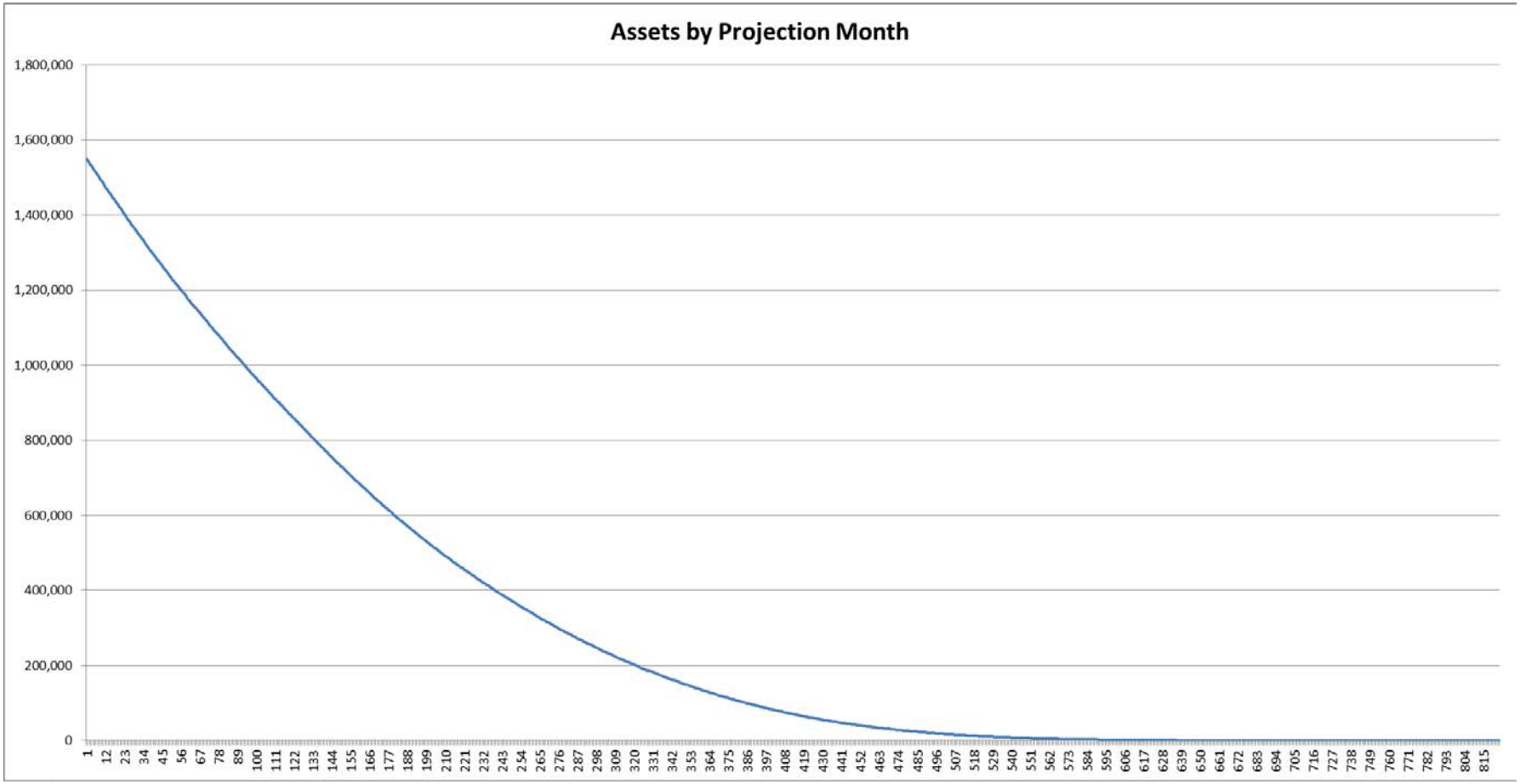
Direct Iteration

SUMMARY BALANCE SHEET AND STATISTICAL ITEMS

	0 11/2012 to 12/2012	1 12/2012 to 01/2013	2 01/2013 to 02/2013	3 02/2013 to 03/2013	4 03/2013 to 04/2013	5 04/2013 to 05/2013	6 05/2013 to 06/2013
STATUTORY BALANCE SHEET							
Invested assets	0	1,541,997	1,531,278	1,520,471	1,509,712	1,499,000	1,488,333
Policy loan balance	0	0	0	0	0	0	0
Other ledger assets	0	0	0	0	0	0	0
Cash balance	1,550,205	167	32	32	33	33	34
Accrued investment income	0	0	4,090	8,179	12,269	16,359	20,449
Net deferred premiums	0	0	0	0	0	0	0
TOTAL ASSETS	**1,550,205**	1,542,164	1,535,399	1,528,683	1,522,014	1,515,392	1,508,816
Aggregate policy reserves	1,490,778	1,484,242	1,477,761	1,471,334	1,464,960	1,458,637	1,452,366
Total IMR balance	0	0	0	0	0	0	0
Loan balance	0	0	0	0	0	0	0
Other ledger liabilities	0	0	0	0	0	0	0
TOTAL STATUTORY LIABILITY	1,490,778	1,484,242	1,477,761	1,471,334	1,464,960	1,458,637	1,452,366
Target Surplus	0	0	0	0	0	0	0
Free surplus	59,427	57,922	57,638	57,349	57,055	56,755	56,450
TOTAL SURPLUS	59,427	57,922	57,638	57,349	57,055	56,755	56,450
TOTAL LIABILITIES AND SURPLUS	1,550,205	1,542,164	1,535,399	1,528,683	1,522,014	1,515,392	1,508,816
STATISTICAL ITEMS							
Lives in force *	206.000	204.700	203.411	202.133	200.867	199.611	198.366
Units issued in current cycle *	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Insurance in force	1,846,068	1,836,762	1,827,533	1,818,379	1,809,300	1,800,295	1,791,361
Annualized premium in force	3,876	3,847	3,819	3,791	3,763	3,736	3,709
Policy count in force *	206	205	203	202	201	200	198
Account value in force	1,490,778	1,484,242	1,477,761	1,471,334	1,464,960	1,458,637	1,452,366
Total general account value in force	0	0	0	0	0	0	0
Separate account 1 account value in force	0	0	0	0	0	0	0
Separate account 2 account value in force	0	0	0	0	0	0	0
Separate account 3 account value in force	0	0	0	0	0	0	0
Total cash value in force	1,490,778	1,484,242	1,477,761	1,471,334	1,464,960	1,458,637	1,452,366
Tax tabular reserve in force	1,490,778	1,484,242	1,477,761	1,471,334	1,464,960	1,458,637	1,452,366

Tax net deferred premiums	0	0	0	0	0	0	0
Proxy DAC asset	204	203	203	202	201	199	198
Gross deferred premium	0	0	0	0	0	0	0
Unrealized capital gains	0	0	1,033	2,046	3,039	4,013	4,969
Capital gains	0	0	1	3	4	5	7
Average cycle net investment earnings rate *	0.0000	0.0300	0.0409	0.0407	0.0406	0.0405	0.0404
Average general account credited rate *	0.0401	0.0341	0.0341	0.0341	0.0341	0.0341	0.0341
Average lapse rate *	0.0529	0.0526	0.0524	0.0522	0.0519	0.0517	0.0515

FS(mo=823)	**13.21**
as Percent of Starting Assets:	**0.00%**
Min FS	10


Assets by Projection Month
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1
12
23
34
45
56
67
78
89
100
111
122
133
144
155
166
177
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