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Educational Note

Considerations in the Valuation of Segregated Fund Products

Committee on Life Insurance Financial Reporting

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Members should be familiar with Educational Notes. Educational Notes describe but do not recommend practice in illustrative situations. They do not constitute Standards of Practice and are, therefore, not binding. They are, however, intended to illustrate the application (but not necessarily the only application) of the Standards of Practice, so there should be no conflict between them. They are intended to assist actuaries in applying Standards of Practice in respect of specific matters. Responsibility for the manner of application of Standards of Practice in specific circumstances remains that of the member in the life insurance practice area.

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Memorandum

To: All Life Insurance Practitioners

From: Jacques Tremblay, Chairperson
Practice Council

Tyrone G. Faulds, Chairperson
Committee on Life Insurance Financial Reporting

Date: November 22, 2007

Subject: **Educational Note – Considerations in the Valuation of Segregated Fund Products**

The Committee on Life Insurance Financial Reporting (CLIFR) has developed the attached Educational Note – Considerations in the Valuation of Segregated Fund Products. It presents considerations and examples of the application of the Standards of Practice to the valuation of Segregated Fund products in Canadian financial statements prepared in accordance with Generally Accepted Accounting Principles (GAAP).

CLIFR has solicited input from the Committee on the Appointed/Valuation Actuary and the Task Force on the Valuation of Segregated Fund Guarantees. No issues were raised by these parties.

CLIFR is currently reviewing Section 2300 of the Standards of Practice in connection with the wording of section 3.1 of this educational note. This section deals with the term of the liability for segregated fund guarantees. CLIFR's interpretation of this section of the Standards is that for segregated fund contracts with no material constraints, the term of the liability ends at the balance sheet date if the liability would otherwise be negative. The term of the liability for these contracts would be extended beyond the balance sheet date to the date that maximizes the liability. However, for fully guaranteed segregated fund contracts the implication is that the term of the liability would be the life of the contract. CLIFR's view is that the term of the liability for the fully guaranteed contracts would be determined in the same manner as for contracts with no material guarantees.

CLIFR is likely to recommend changes to the Standards to address this issue.

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In accordance with the Institute's Policy on Due Process for the Approval of Guidance Material other than Standards of Practice, this educational note has been approved by CLIFR and has received final approval for distribution by the Practice Council on November 21, 2007.

We would like to thank the members of CLIFR who were primarily responsible for the development of this educational note: Jacques Boudreau, Byron Corner, Gregory Lawrence and Dale Mathews.

Should you have any queries or comments regarding this educational note, please contact Tyrone Faulds at Ty.Faulds@londonlife.com.

JT, TGF

1. INTRODUCTION

This educational note provides considerations and examples of the Standards of Practice as applied in the valuation of segregated fund policy liabilities to be used in Canadian financial statements prepared in accordance with Generally Accepted Accounting Principles (GAAP).

It does not address specifically the techniques of stochastic modeling, but rather deals with a number of practical aspects of the valuation where there appears to be a wide range of practice among insurers and where additional guidance has been requested.

1.1 Abbreviations

The following abbreviations are used throughout this educational note:

AAE – Allowance for Acquisition Expense

CALM – Canadian Asset Liability Method

CTE – Conditional Tail Expectation

MfAD – Margin for Adverse Deviations

PfAD – Provision for Adverse Deviations

2. VALUATION METHOD

2.1 General Approaches

There are two ways to value additional benefits or guarantees associated with policies for which an Allowance for Acquisition Expense (AAE) is being amortized.

The actuary is reminded of paragraph 2320.24 of the Standards of Practice, which states,

> The balance of acquisition or similar expenses would be written down to zero using an appropriate method. Such a method would:
>
> > have a term consistent with the extended term established at inception,
> >
> > have a write-down pattern reasonably matched with the net cash flow available to offset these expenses at inception, and
> >
> > be locked in, so the amount of write-down in each period will not fluctuate from the expected amount established at inception provided such balance is recoverable from the additional cash flow recognized at the balance sheet date, and where not fully recoverable at the balance sheet date, is written down to the recoverable amount, with the expected amount of write-down in each future period proportionately reduced.

Bifurcated Approach

Revenue is allocated between recoverability testing of the AAE and the liability for the guarantee. The portion allocated to the guarantee would generally be based on the additional charge priced into the product for that guarantee. The policy liability for the guarantee is calculated separately using the net cash flows available excluding those allocated to amortize the remaining unamortized AAE. The allocation of future revenues

between amortization of the AAE and the guarantee does not change from period to period.

Whole Contract Approach

Under this approach all net cash flows available are considered in determining the total liability. There are several variations of the Whole Contract Approach. Some of them do not involve an explicit testing of the recoverability of the unamortized AAE, but instead calculate only a total liability. This total liability will change from period to period as a result of market movements and other factors and could, therefore, implicitly include a writing down of the AAE. Therefore, this approach could allow the unamortized AAE to increase in a subsequent period. Any variation that allows this possibility is inconsistent with paragraph 2320.24 of the Standards of Practice.

> One common variation which does not allow this is sometimes referred to as a "Deferred Acquisition Cost (DAC) or AAE focused" approach. Future revenues are first allocated entirely to the AAE to ensure its recoverability on a best estimate with margins basis at the desired conditional tail expectation (CTE) level. Should the AAE be unrecoverable it would be written down to the recoverable level with the future write-down amounts reduced accordingly and locked in, consistent with paragraph 2320.24 of the Standards of Practice. If conditions improved in the future, the AAE would not be written back up. Then the total policy liability is determined using all net cash flows. The unamortized AAE balance must then be added back to determine the liability for the guarantee.

Total Policy Liability = Value (Future Gtee Costs and Expenses) – Value (Total Future Revenue)

Liability for Gtee = max (0, Total Policy Liability + Unamortized AAE)

As a simple example, assume the following for a particular scenario.

> Present value of total future revenue = $400
>
> Unamortized AAE = $350
>
> Present value of guarantee costs and expenses = $100

Under these assumptions, the total liability would be $100 - $400 = $(300).

The liability for the guarantee would be $(300) +$350 = $50 since $350 of revenue is earmarked to cover amortization of the AAE.

This form of the Whole Contract Approach will be assumed in the remainder of this note.

2.2 Considerations

The two approaches described above will produce different levels of liability and earnings patterns over the life of the contract. The following observations may be useful.

> The total liability under the Whole Contract Approach will be less than or equal to that under the Bifurcated Approach because, in the former case all future revenue is taken into consideration. As a consequence, the calculated liability for the guarantee is more likely to be negative under the Whole Contract Approach. Imposition of a zero floor will result in a more stable liability over this period.

Once the liability for the guarantee has become positive under the Whole Contract Approach, the liability will tend to be more volatile than under the Bifurcated Approach because the implicit allocation of revenue between the AAE and the guarantee may change from period to period. For example, if markets deteriorate the liability for the guarantees would be expected to increase under both approaches. However the effect will be exaggerated under the Whole Contract Approach since more revenue will be needed to recover the AAE and the allocation to the guarantee will decrease.

The Whole Contract Approach will defer possible writing down of the AAE as long as possible because the AAE has first priority on all revenue.

The Bifurcated Approach might be more appropriate when a hedging program is in place for the segregated fund guarantees. Assuming the cash flows being hedged would include a component related to expected revenue, it would be difficult to anticipate the effect of market movements on these cash flows in the modeling if the allocation of fee income to the guarantees is changing from period to period.

Both approaches, as described above, are considered to be consistent with current standards and the Committee on Life Insurance Financial Reporting is not recommending one over the other at this time. The above guidance may be reconsidered as the direction of International Standards becomes clearer.

2.3 Examples

Appendix A contains examples showing how the policy liability might be expected to react under different market conditions under the two approaches to valuation.

3. TERM OF THE LIABILITY FOR SEGREGATED FUND GUARANTEES

3.1 General Considerations

Paragraph 2320.27 of the Standards of Practice states, "...the term of the liabilities ends at the balance sheet date for…the general account portion of a deferred annuity with segregated fund liabilities but without guarantees; for example with no guarantee of the segregated fund value."

When a guarantee exists, paragraph 2320.22 of the Standards of Practice, reproduced below, needs to be interpreted.

> The term of the liability ends at the earlier of
>
> > the first renewal or adjustment date at or after the balance sheet date at which there is no constraint, and
> >
> > the renewal or adjustment date after the balance sheet date which maximizes the policy liabilities."

It is this committee's view that, for segregated fund contracts with no material constraints, the term of the liability ends at the balance sheet date if the liability would otherwise be negative. The corollary of this is that the liability for the guarantees (i.e., before AAE) is set at a zero floor.

The above also indicates that testing would be done to determine the number of renewal periods to be reflected in the term of the liability for the guarantee. Extending the term to recognize future renewal periods would be done only if this increases the liability, consistent with the above guidance.

3.2 Hedging

Segregated Fund guarantees have significant risk and are often hedged. However, application of a zero floor on the liability can disrupt the parity between the asset and liability sides of the balance sheet as described below.

Paragraph 2320.02 of the Standards of Practice indicates that, under the Canadian Asset Liability Method (CALM) "*The amount of policy liabilities by that method for a particular scenario is equal to the amount of supporting assets at the balance sheet date which are forecasted to reduce to zero at the last liability cash flow in that scenario.*"

When the calculated liability is negative, and therefore set at a zero floor, it might be expected that there would be no invested assets backing this liability. However, with a hedging program in place, the underlying derivative assets could have a starting value of zero, but this value would change from period to period, becoming positive or negative depending on market movement.

This change in the fair market value of the derivatives flows through investment income and would be expected to be offset (not necessarily exactly) by a change in the calculated liability. This balance can be disturbed by the zero floor on the liability side and can result in a balance sheet presentation which is inconsistent with the movement in markets over the reporting period.

A simple example will illustrate this.

Consider a maturity guarantee at the end of one year equal to the initial deposit of $1,000. The liability is being calculated on a best estimate basis. Two paths are considered, the fund value moving to $1,100 or $900, each with 50% probability. An initial fee of $50 is collected.

The liability before hedging is calculated as follows:

State	Fund Value (t=1)	Claims cost	Premium (t=0)	PV cash flows at 5.5%
Path 1 Up	1,100	0	50	50
Path 2 Down	900	100	50	(44.79)

The calculated liability at time zero is 0.5 x (50) + 0.5 x 44.79 = (2.61) which is set at zero floor.

Hedging is done using futures contracts (0.5 units). The current value of one unit of the stock is $1,000. The risk free interest rate is 5.50%. The future price of one unit of stock is therefore $1,055 with $0 initial cost of the derivative. The choice of 0.5 units is based on sensitivity testing of the change in the cost of the guarantee relative to a change in the market.

Assuming a perfect hedge, the total cash flows would be the same for both paths as shown in the following table. This results from the effect of the hedge, which is essentially to produce a 5.5% return regardless of the path.

State	Price after one year	Cash flow from futures contracts	PV cash flows from futures contracts at 5.5%	PV Liability cash flows at 5.5%	PV total cash flows at 5.5%
Path 1 Up	1,100	(22.50)	(21.33)	50.00	28.67
Path 2 Down	900	77.50	73.46	(44.79)	28.67

The cash flows from the futures contracts are developed as follows.

Path 1: If the market goes up as indicated, a loss will arise from the futures contract as a result of buying a unit of stock at $1,100 and selling for $1,055.

($1,055 - $1,100) x 0.5 = $(22.50)

Path 2: Similarly, if the market goes down, a gain will result from selling at $1,055 a unit of stock purchased at $900.

($1,055 – $900) x 0.5 = $77.50

The total reserve at the outset is $(28.67) which again is set at zero floor. The statement value of the assets supporting this liability is zero.

Now consider what happens if there is an immediate up-tick of 1% in the market.

Assume for simplicity that the two paths remain unchanged, i.e., there are still two possible fund values at the end of one year, $1,100 and $900, each with a probability of 0.5. In this situation the liability cash flows will remain unchanged and the initial 0.5 units of futures contracts is still appropriate to decrease the liability cash flows.

However, the fair market value of the futures contracts will drop because of the up tick in the equity market. The purchase price of a unit of stock at the end of one year will now be $1,065.55 assuming a risk free rate of 5.5%, and the portfolio will lose $5.00 of value.

This is calculated as 0.5 x ($1,055.00 – $1,065.55)/1.055 = $(5.00)

In this example, the futures contracts initially chosen to back the policy liabilities had a statement value of zero consistent with the term of the liability. These assets are still appropriate after the market up tick but their fair value has changed.

If the total reserve is always floored at zero, the following income will result over the initial period, during which markets have improved and the risk position has not changed.

Investment income: $(5.00)

Change in reserve: 0

Total: $(5.00)

Note – In practice, it would be expected that the market up-tick would result in a change in the stochastic paths and liability cash flows with a consequent repositioning of the futures contracts. The effects would be expected to be largely offsetting.

Conclusion

This committee believes that it would be appropriate to consider both sides of the balance sheet in determining the term of the liability in the context of hedging. The effects described above would be considered to be an unforeseen situation in the context of the following paragraphs of the General Standards.

Paragraph 1330.01:

> "*Deviation from a particular recommendation or other guidance in the standards is accepted actuarial practice for an unusual or unforeseen situation for which the standards are inappropriate.*"

Paragraph 1330.03:

> Accepted actuarial practice evolves. The standards are not intended to inhibit research and discussion which contribute to that evolution. In an unusual or unforeseen situation, they may produce an inappropriate result and are therefore no substitute for sound judgment.

This interpretation suggests that a negative liability could be acceptable subject to constraints on the amount of profit capitalized, consistent with an unhedged position.

In the above example, it would be appropriate to set the initial hedged reserve at a zero floor. This would be consistent with the term of the liability ending at the balance sheet date. However, in the first period, an adjustment could be made to allow the change in reserve to reflect the change in the fair market value of the hedge assets as a result of market movement.

4.0 RECOVERABILITY TESTING FOR THE ALLOWANCE FOR ACQUISITION EXPENSES

4.1 Amortization period for AAE and Extended Term for Recoverability Testing

A common consideration in the valuation of segregated funds is the Allowance for Acquisition Expenses (AAE) on the balance sheet. Typically, an actuary makes allowance for "acquisition or similar expenses" upon issuing the contract in the form of a negative policy liability, in accordance with paragraph 2320.24 of the Standards of Practice. This allowance is made giving due consideration to its recoverability from future cash flows assumed in the valuation. Such cash flows may result from an extension of the term of the liability in accordance with paragraph 2320.23. The pertinent portions of subsection 2320 of the Standards of Practice are as follows:

.23 The actuary would extend such term solely to permit recognition of cash flow to offset acquisition or similar expenses

> whose recovery from cash flow that would otherwise be beyond such term was contemplated by the insurer in pricing the policy, and
>
> where the value of the additional cash flow recognized by such

extension of the term cannot exceed the value of the remaining balance of acquisition or similar expenses.

.24 The balance of acquisition or similar expenses would be written down to zero using an appropriate method. Such method would:

have a term consistent with the extended term established at inception,

have a write-down pattern reasonably matched with the net cash flow available to offset these expenses at inception, and

be locked in, so the amount of write-down in each period will not fluctuate from the expected amount established at inception provided such balance is recoverable from the additional cash flow recognized at the balance sheet date, and where not fully recoverable at the balance sheet date, is written down to the recoverable amount, with the expected amount of write-down in each future period proportionately reduced.

Realizing the revenues to cover the amortization charges is equivalent to demonstrating recoverability of the unamortized AAE. Recoverability would be tested at least annually. If the actuary determines that less than the full amount is recoverable under the valuation approach selected (bifurcated or whole contract), the actuary would reduce the unamortized AAE to the amount recoverable on the balance sheet date and proportionately reduce the remaining future write-down amounts. Although the standards do not state this explicitly, it is understood that once the write-down amounts are reduced, they would not be written back up to the original amounts (for example, if markets subsequently recovered).

Paragraph 2320.23 of the Standards of Practice limits the amount of cash flow recognized to an amount "whose value cannot exceed the value of the remaining balance of acquisition or similar expenses". This implies that the extended term would change from period to period in reaction to the amount of AAE remaining and changes in future cash flow patterns as of result of market movement and other factors.

It is this committee's view that the write-down pattern for the AAE would be considered and constructed carefully since it is locked in after being established. In order to be "reasonably matched", the pattern would be expected to make sense in terms of portfolio revenue expectations, giving consideration to both amount and predictability (net fee revenue patterns and protection in the form of surrender charges that help ensure realization in one form or another).

A component of this pattern is the period over which to amortize the AAE, i.e., the length of the write-down pattern. Paragraph 2320.24 of the Standards of Practice indicates that the method for writing the AAE down to zero would "have a term consistent with the extended term established at inception." This suggests that the amortization period would not be materially different from the extended term calculated when the AAE is established.

Over time, the remaining amortization period may differ from the extended term for recovery of the AAE. The amortization period is locked in, but the period for

recoverability testing of the AAE is adjusted to recognize only that amount of cash flow needed to recover the AAE.

For example, if markets do well, the extended term for recoverability testing might be expected to become shorter than the amortization period. Conversely, if markets do poorly, the extended term for recovery may *temporarily* be longer than the amortization period. In both cases, however, they must both become zero at the end of the locked in amortization period. In the interim, higher or lower income than initially projected will be recognized to effect this.

As a simple example, assume that for a block of business, the amortization period is 10 years starting from issue and at issue the extended term for recoverability is also 10 years. On a best estimate basis, earnings are expected to be $100 per year over this 10-year period.

Should markets perform better than expected, the extended term for recoverability would be shortened, say to eight years. If the amortization period were also shortened to eight years, the effect of the faster amortization would offset the higher revenue over those eight years. However, the amortization period is locked in, so the AAE will continue to be amortized at the initial rate and earnings over the 10 years would be higher than the initial projection of $100.

Over this 10-year period, assuming nothing else changes, the extended term for recoverability will gradually move back from eight to 10 years since the AAE will not be fully amortized until the end of the 10-year period. At that point, both terms will be zero.

The cash flows recognized in testing for recoverability would include margins for adverse deviations, with the direction of margin being appropriate for the whole contract. For example, a reduction to the expected lapse rate may be favourable for AAE recoverability, but may trigger additional guarantee costs, thus increasing the liability for the guarantees. The actuary will recognize that both an increase and decrease from the expected lapse rate cannot materialize at the same time for the contract. The appropriate direction will depend on many factors, including the plan design as well as how deep the guarantees are in the money. The actuary would determine the appropriate direction through testing, using a reasonable level of aggregation. Section 5 discusses further considerations with respect to level of aggregation.

4.2 Choice of CTE Level

Another consideration for AAE recoverability is the choice of CTE level for recognizing future cash flows. A range of possibilities exists including:

> ***CTE(0):*** The most likely argument for using CTE(0) is that recoverability testing for AAE is an accounting principle, and the accounting profession generally tests recoverability for such assets using a "more likely than not" basis. A corollary to this reasoning is that the cash flows recognized in the testing would *not* include Margins for Adverse Deviations (MfAD), contrary to the suggestion in the foregoing paragraph. Although there is intuitive appeal to this approach, the committee believes accepted actuarial practice in Canada requires some provision for adverse deviation in the recoverability testing exercise since the future cash flows are uncertain.

CTE(60) – CTE(80): This approach is consistent with the view that since the AAE is a policy liability, stochastic testing of its recoverability is governed by paragraph 2320.51 of the Standards of Practice.

CTE(95): This approach is equivalent to testing for recoverability at a confidence level appropriate for solvency purposes, and therefore is considered by CLIFR to be outside the range of accepted actuarial practice for a liability item under GAAP.

Given the issues and considerations outlined above for each of the approaches described, the committee believes the appropriate approach is to test for recoverability at the CTE(60) – CTE(80) level. The CTE level used for recoverability testing of the AAE need not be the same as that used for the calculation of the guarantee. This recognizes that the considerations the actuary makes in choosing a CTE level for the guarantees (most importantly the degree of risk) do not necessarily apply in the same manner when testing for recoverability of the AAE. From a practical perspective, however, it may make sense to keep these levels the same when the Whole Contract Approach is being used.

For guidance on the issue of whether or not the CTE level is kept constant or allowed to change from period to period, the actuary is referred to Section 5 of the November 2006 educational note "Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations."

5. LEVEL OF AGGREGATION

An issue to consider is the level of aggregation at which to test for recoverability of the AAE and for calculation of the liability for guarantees. Paragraph 2320.22 of the Standards of Practice defines the term of the liability at the policy level. Paragraph 2320.09 presents CALM as an aggregate methodology stating,

> The actuary would usually apply the Canadian asset liability method to policies in groups which reflect the insurer's asset liability management practice for allocation of assets to liabilities and investment strategy. That application is a convenience, however, which would not militate against calculation of policy liabilities that, in the aggregate, reflect the risks to which the insurer is exposed.

This apparent conflict suggests that judgment is required on the part of the actuary to determine an appropriate level of aggregation.

One approach in practice is to divide the business into cohorts and apply a zero floor to the total calculated reserve (before AAE) for each cohort. With this approach, care must be taken to understand the possible effect on the year by year liability.

This issue is illustrated by the following simple numerical example and a preferred approach is then presented.

Consider two cohorts of policies:

> Cohort 1 consists of business sold in 1999 when the Standard & Poor's (S&P) 500 was at 1,455.
>
> Cohort 2 consists of business sold in 2002 when the S&P 500 was at 975.

Assume that the S&P 500 is now at 1,250 and that

Cohort 1 is deep *in* the money and has one year left to maturity.

Cohort 2 is deep *out of* the money and has four years left to maturity.

The following illustrates the calculation of a liability without margins, assuming a discount rate of 5% for the scenario being tested.

Approach 1: The liabilities for cohorts 1 and 2 are calculated separately with a zero floor applied at the cohort level.

Cohort 1:

Year	Claims at Year-End	Fee Income at Year-Start	Present Value of Claims	Present Value of Fees	Liability without Floor	Liability with Floor
0			952	100	852	852
1	1,000	100	1,000	0	0	0

The following income pattern results for this cohort.

Year	Fee income	Interest	Claims	Change in Liability	Total
1	100	48	(1,000)	852	0

Cohort 2:

Year	Claims At Year-End	Fee Income at Year-Start	Present Value of Claims	Present Value of Fees	Liability without Floor	Liability with Floor
0			0	1,675	(1,675)	0
1		450	0	1,287	(1,287)	0
2		450	0	879	(879)	0
3		450	0	450	(450)	0
4	0	450	0	0	0	0

The following income pattern results for this cohort assuming the zero floor is applied.

Year	Fee income	Interest	Claims	Change in Liability	Total
1	450	23	0	0	473
2	450	23	0	0	473
3	450	23	0	0	473
4	450	23	0	0	473

For cohort 1, a liability has been built up to cover the claims at the end of the next year. For cohort 2, the application of the zero floor results in earnings emerging on a cash flow basis.

Approach 2: Cohorts 1 and 2 are combined and set at the zero floor applied to the calculated liability in total.

Year	Claims At Year-End	Fee Income at Year-Start	Present Value of Claims	Present Value of Fees	Liability without floor	Liability with Floor
0			952	1,775	(823)	0
1	1,000	550	1,000	1,287	(1,287)	0
2	0	450	0	879	(879)	0
3	0	450	0	450	(450)	0
4	0	450	0	0	0	0

The following income pattern results from application of the zero floor.

Year	Fee income	Interest	Claims	Change in Liability	Total
1	550	28	(1,000)	0	(423)
2	450	23	0	0	473
3	450	23	0	0	473
4	450	23	0	0	473

This approach produces an inappropriate result since the two combined cohorts do not have similar risk profiles. In particular, the term of the liability would be one year for cohort 1, but would end at the balance sheet date for cohort 2.

Recommended Approach

The committee believes that the calculation of the liability can be performed at the segment level, as long as testing is done to determine the term that maximizes the liability at each duration. Using the data from the above example, cash flows from the two cohorts would be combined. Then, at each duration a liability would be calculated for each possible term from the balance sheet date until the date at which the last cash flow will occur. The booked liability at each duration would be that corresponding to the term producing the highest liability at that duration.

Based on the combined cash flows from Approach 2 above, the following table summarizes the liabilities calculated at each duration for the various terms. The shaded amounts indicate the liabilities to be booked.

Calculated liability:

Duration	Term = 4	Term = 3	Term = 2	Term = 1	Term = 0	Booked
0	(823)	(434)	(26)	402	0	402
1	(1,287)	(879)	(450)	0		0
2	(879)	(450)	0			0
3	(450)	0				0
4	0					0

The following income pattern emerges:

Year	Fee income	Interest	Claims	Change in Reserve	Total
1	550	48	(1,000)	402	0
2	450	23	0	0	473
3	450	23	0	0	473
4	450	23	0	0	473

Summary:

The following table summarizes the results for the three approaches.

	Approach 1 Zero floor by cohort	Approach 2 Zero floor aggregate	Recommended Solve for term
Starting liability	852	0	402
Income in year			
1	473	(423)	0
2	473	473	473
3	473	473	473
4	473	473	473

The recommended approach produces the most appropriate result since it sets up just enough liability to ensure that losses do not occur if experience emerges on a best estimate basis. In practice, due to the complexities of stochastic modeling, it may not be practical to implement the above approach at a segment level and cohorts may be established where a term of the liability for each cohort is selected based on testing as described above. A key consideration for determining the appropriate level of aggregation is the homogeneity of policies with respect to key risk parameters (market performance, product features, lapse, mortality, guarantee resets behaviour, and so forth).

Note: the above example was constructed using a liability without margins which results in income of zero when the term of the liability has been extended beyond the balance sheet date. In practice, some release of PfAD would be expected.

6. DISCOUNTING AND C3 PfAD

The C-3 PfAD for segregated fund guarantees must be established consistent with CALM principles. This means that this PfAD would reflect the reinvestment or disinvestment exposure of these policy liabilities and their supporting assets. The Standards of Practice allow the actuary to determine this PfAD using either a deterministic or a stochastic application, though in practice a deterministic application may be the only practical alternative for these policy liabilities.

It may be impractical to do roll forward CALM cash flow testing as part of the stochastic application for determining the value of the guarantees; i.e., to cash flow test, including matching asset cash flows, along each path of the stochastic application used to generate the policy returns. This means that an approximation method is typically used. A fairly simple approximation may, in fact, be acceptable if it can be demonstrated that the C3 risk is very small relative to the market option risk. This will often be the case if the term of the liabilities is relatively short and the supporting assets have a similar term.

Scenario testing can be conducted to determine the sensitivity of the policy liabilities to a range of reinvestment assumptions. These results can be a helpful guide to choosing and calibrating the approximation method.

The most common approximation method is the discounted cash flow method. If the supporting assets are of a fixed income type, this might involve using a fixed interest rate assumption to discount all future cash flows in each stochastic scenario.

The following points would be considered in developing the discount rate in such an approximation method:

> The resulting liability would be related to the current statement value of the assumed supporting assets as reflected in the current book yield of those assets. If the supporting assets are designated Held For Trading (HFT), this means the discount rate would be a function of the yield inherent in the assets' current fair value at the balance sheet date unless the actuary otherwise adjusts the resulting liability to relate it appropriately to the statement value of the assets. The result is that the discount rate may vary from one period to the next.
>
> The C-3 MfAD (adjustment to the discount rate) would reflect the level of mismatch and would be calculated or justified by roll forward cash flow testing (see below). The greater the extent to which the term and/or cash flows of the supporting assets are different from the term and/or cash flows of these policy liabilities, the greater the required C-3 MfAD.

The actuary would choose the policy cash flows used in the roll forward cash flow testing carefully to ensure that such are representative and appropriate. These cash flows could be:

> the average of the cash flows for the scenarios that define the policy liability (i.e., if the policy liability is set at CTE(70), then the tested cash flows would be the

average of the cash flows, period-by-period, of the 30% of the scenarios that produce the highest policy liability using a single discount rate), or

a representative path chosen as most consistent with the key drivers of the policy liability, e.g., for a typical maturity guarantee, the significant expected outflows are maturity guarantee payments for cohorts most "in the money."

A final consideration is the common situation where there are no tangible assets in the general account supporting policy liabilities, for example, because unamortized AAE outweighs the liability for the guarantees (thus, the net policy liability is negative). In this situation, the actuary has no current asset cash flows to project and often limited positive cash flows to reinvest, unless the valuation makes an assumption for future premium payments. Where this is the case, the actuary would rely largely on a borrowing strategy, making an appropriate assumption for borrowing costs given the insurer's circumstances.

7. POLICYHOLDER-RELATED ASSUMPTIONS

7.1 Best Estimate Assumptions

The actuary would include all relevant forms of policyholder-related assumptions, including but not limited to the following:

mortality,

surrenders,

partial withdrawals (systematic and elective),

fund transfers (switching/exchanges),

resets/ratchets of the guaranteed amounts (automatic and elective),

elective resets of the maturity and/or annuitization dates,

future deposits.

Moreover, policyholder-related assumptions could vary according to such characteristics as:

gender,

attained age,

issue age,

contract duration,

time to maturity,

tax status,

fund value,

market value/guaranteed value ratio,

investment option,

guaranteed benefits amount,

surrender charges and/or transaction fees.

The soundness of the assumptions will depend on the quality of the data upon which they are based and the actuary would attempt to track experience by collecting and maintaining the data required to conduct credible and meaningful studies of policy holder-related assumptions. Many companies have been selling segregated funds for a number of years and would be expected to have meaningful data on hand.

However, given the large number of variables that can influence certain assumptions, it is unlikely that experience studies can be sufficiently complete to cover all permutations of variables and behaviour. In selecting the assumptions, the actuary would also be guided by the following general principles:

The exercise of options is strongly correlated with being in-the-money.

Anti-selection will result in increased exercise of the more valuable options.

The premise to the actuary's assumptions would be that policyholder decisions will tend to serve their perceived interest and not serve the insurer's interest unless the two run together.

The actuary's best estimate would depend on the sophistication and perceived interest of the policyholder.

The actuary need not assume that all policyholders always act in a rational manner, or that they do so with perfect efficiency.

In very sophisticated models, the interaction of all of the assumptions can be difficult to understand so the actuary would proceed with caution when using models that produce results that are counterintuitive.

Each category of policyholder-related assumption is discussed in more detail below.

a) Mortality

The mortality assumption would be based on past and expected future experience to the extent that credible data can justify such an assumption. Otherwise, the actuary would assume mortality consistent with that used in valuing similar contracts, reflecting the form of underwriting (if any), and other policy attributes.

b) Surrenders

In general, the policy liabilities for the investment guarantees on segregated funds are very sensitive to the assumed lapse rates. In many circumstances, the products may be considered lapse-supported to the extent that lower lapse rates increase policy liabilities. Unless the actuary has relevant and credible experience data to support different assumptions, he or she would not assume lapse rates that differ materially from industry experience and/or any guidance offered by the CIA and its practice committees.

In particular, the actuary would normally assume that surrenders will decrease when the fund value/guaranteed amount ratio decreases (i.e., when the maturity guarantee is more deeply in the money), although some minimum non-zero surrender rate would normally be appropriate (i.e., resulting from terminations unrelated to

maturity guarantee value). However, when the fund value/guaranteed amount ratio is very high, surrender experience may be comparable to investment funds that do not offer a guaranteed benefit (e.g., most mutual funds). Furthermore, surrenders would typically be expected to spike temporarily once surrender charges (back-end loads) wear off and decline as the time-since-issue increases.

Care must be taken to ensure that the overall rate of fund depletion (i.e., the combined effects of surrenders and partial withdrawals) is appropriate.

c) Partial withdrawals

To the extent that such withdrawals: a) can reasonably be anticipated, and b) would justifiably be treated differently from surrenders, the actuary would assume that some policyholders will withdraw monies without surrendering their contracts. Ideally, the assumption for the frequency (timing) and/or amount of transfers would vary according to the current and/or historical economic environment and past policyholder behaviour. Care must be taken in setting the withdrawal assumptions so that they interact with surrenders in a reasonable manner and so that the overall level of fund depletion is appropriate.

Where applicable, the actuary would make allowance for pre-authorized (systematic) withdrawals consistent with client instructions and any restrictions imposed by the contract or legislation. The actuary would also attempt to reflect the periodic distribution of investment income from the fund if such amounts are not automatically reinvested.

d) Fund transfers

The actuary would assume that some contract holders will transfer monies between investment options to the extent that such transfers increase the policy liabilities and can be reasonably justified. Transfer rates would typically contain both fixed (non-dynamic) and variable (dynamic) components. Ideally, the assumption would be for the frequency (timing) and/or amount of transfers to vary according to the current and/or historical economic environment and past policyholder behaviour.

The dynamic component of the transfer rate can reasonably be expected to vary according to the degree to which the investment guarantee is in-the-money and the expected performance differential between the source and destination funds.

e) Elective resets of the guaranteed amounts

The actuary would assume that some proportion of contract holders elect to exercise the discretionary reset option when it is in their best financial interest to do so.

The reset utilization rate (fraction of policyholders who choose to reset) would vary over time according to the relationship between current guaranteed amount (before reset) and fund value. The utilization rate can be expected to rise whenever the investment guarantees are out-of-the-money (i.e., when the ratio of fund value to guaranteed amount is greater than one). The rate of utilization would recognize the market value/guaranteed value ratio (option value component), historical returns (performance component) and the remaining term-to-maturity (time component).

To the extent that relevant and credible data are available, the base reset utilization rate would be consistent with company and industry experience. The actuary would allow for both rational (financially motivated) and irrational behaviour by assuming that some threshold needs to be reached before resets occur. The actuary would recognize, further, that a certain proportion of policyholders will not reset even when to do so may be a financially optimal decision.

If the maturity date is also re-established upon reset, the utilization rate will likely fall as attained age increases and the term-to-maturity shortens.

f) Elective Resets of the maturity dates

If policyholders have the option to change their maturity dates after contract issue, the actuary would assume some proportion of policyholders will elect the shortest possible maturity.

g) Future deposits

The actuary may wish to assume some level of future deposits in the short term if the fund is open to new money and to the extent that such deposits increase the policy liabilities (e.g., deposit-level guarantee and a fixed maturity date). In this case, the level of future deposits would be consistent with recent experience and reasonable policy behaviour. Monies would be allocated to the various investment options in a manner consistent with past behaviour and recent client instructions.

7.2 Margins for Adverse Deviations

The actuary would make provision for adverse deviations by testing the effect on policy liabilities of plausible alternative policyholder-related assumptions and adopting one with relatively high policy liabilities.

The actuary would also incorporate MfADs for all risk factors that are non-dynamic (i.e., the non-scenario-tested assumptions) and are assumed not to vary according to the financial interest of the policyholder. Margins would normally fall in the standard range of 5% to 20%. High margins would normally be applicable for assumptions that are not supported by credible and relevant experience data.

Risk factors that are not scenario tested, but could reasonably be expected to vary according to a) a stochastic process, or b) future states of the world (especially in response to economic drivers), may require additional margins and/or signal a need for higher margins for certain other assumptions.

Behaviour that is modeled dynamically would incorporate margins by reflecting potential adverse experience in a reasonable manner.

Care would be taken to ensure that any modeled dynamic behaviour reasonably reflects the possible range of future experience and is consistent with the other variables in the model, including the non-scenario-tested assumptions.

8. PROVISION FOR ADVERSE DEVIATIONS

For most products sold by life insurance companies, it is usually straightforward to determine the PfADs. However, that is not the case for segregated funds products. The

lack of guidance for these products has led to a wide range of practice in the reporting of segregated fund PfADs. In particular, some companies include as part of the PfADs those margins that are not recognized when the term of the liability is zero, while others do not.

Paragraph 1110.39 of the Standards of Practice states, "Provision for adverse deviations is the difference between the actual result of a calculation and the corresponding result using best estimate assumptions."

Paragraph 2320.53 adds, "The provision for adverse deviations in respect of each assumption other than the scenario-tested assumptions results from a margin for adverse deviations included in that assumption."

Finally, paragraph 2350.02 states, "Provided, however, that, if a margin for adverse deviations cannot be defined as a percentage of the best estimate assumption, then the related provision for adverse deviations would be taken as the increase in policy liabilities which results from substitution of a conservative assumption for the best estimate assumption.

These standards make it clear that there can only be a PfAD if there is a difference between the actual reserve and the best estimate reserve. If there is no difference, there is no PfAD.

However, there are often additional margins, which can be calculated and disclosed. The following examples show how the total margins could be split between PfADs and additional margins.

All the examples assume that:

a) the best estimate is given by CTE(0) without margins,

b) the policy liabilities are given by CTE(80) with margins,

c) the recoverability testing for the AAE is done at CTE(60).

Example 1

MV/GV = 100%

Initial AAE = 50

Bifurcated Approach

Guarantee – CTE(0)	(a)	(27)		Best estimate Result	
Guarantee – CTE(80)		(17)		Guarantee (f)	0
Amount booked	(b)	0		AAE	(50)
Guarantee margin	(b) – (a)	27		Total	(50)
AAE at CTE(0)	(c)	(67)		Actual Result	
AAE at CTE(60)		(50)		Guarantee (e)	0
Booked	(d)	(50)		AAE	(50)
AAE margin	(d) – (c)	17		Total	(50)
				PfAD (e – f)	0
Total margin		44		Additional Margin	44

The calculations at CTE(0) and CTE(80) both yield guarantee liabilities of 0 because the term of the liability is zero. Since the two results are equal, there is no PfAD. However, the difference between the amount booked and the result of CTE(0) represents an additional margin.

Similarly, the AAE, which would actually be held on a best estimate basis, is the same amount as has been booked, and is recoverable at CTE(60). Therefore, there is no PfAD, but there is an additional margin equal to the difference between the AAE actually held and that which would be recoverable at CTE(0).

Whole Contract Approach

Guarantee – CTE(0) (d)	(94)		Best estimate Result	
Guarantee – CTE(80)	(58)		Guarantee (c)	0
Amount booked	0		AAE	(50)
			Total (a)	(50)
AAE at CTE(0)	(96)		Actual Result	
AAE at CTE(60)	(70)		Guarantee	0
Booked (e)	(50)		AAE	(50)
			Total (b)	(50)
			PfAD (b) – (a)	0
			Additional Margin (c) – (d) + (e)	44

The calculation of the additional margin under the Whole Contract Approach is not as simple as under the Bifurcated one. Since the guarantee liabilities are calculated using all fees, care must be taken to exclude the AAE from the margin.

Example 2

MV/GV = 70%

Initial AAE = 50

In this example, market performance has been poor resulting in a write-down of the AAE from the initial value of 50.

The amount of the write-down is significantly less under the Whole Contract Approach, since all fee income is allocated first to recoverability testing of the AAE. Total margins will now be higher under the Bifurcated Approach since a larger write-down has gone through income.

Bifurcated Approach

Guarantee – CTE(0)	(a)	(19)		Best estimate Result	
Guarantee – CTE(80)		38		Guarantee (f)	0
Amount booked	(b)	38		AAE	(35)
Guarantee margin	(b) – (a)	57		Total	(35)
AAE at CTE(0)	(c)	(48)		Actual Result	
AAE at CTE(60)		(35)		Guarantee (e)	38
Booked	(d)	(35)		AAE	(35)
AAE margin	(d) – (c)	13		Total	3
				PfAD (e – f)	38
Total margin		70		Additional Margin	32

The calculations at CTE(0) still yield a guarantee liability of 0 because the term of the liability is zero. CTE(80) now gives a positive liability and the result between the two constitutes the PfAD. Additional margin is represented by the difference between the guarantee liabilities at CTE(0) with and without the zero floor.

With respect to the AAE, there is still no PfAD. Even though the AAE has been written down in respect of recoverability considerations, the AAE, once written down, can not be written back up. Hence, the best estimate liability for the AAE is the same as that under CTE(60). The difference between the AAE held and that which could be held under CTE(0) is classified as additional margin.

Whole Contract Approach

Guarantee – CTE(0) (d)	(96)		Best estimate Result	
Guarantee – CTE(80)	10		Guarantee (c)	0
Amount booked	10		AAE	(49)
			Total (a)	(49)
AAE at CTE(0)	(66)		Actual Result	
AAE at CTE(60)	(49)		Guarantee	10
Booked (e)	(49)		AAE	(49)
			Total (b)	(39)
			PfAD (b) – (a)	10
			Additional Margin (c) – (d) + (e)	47

9. SAMPLING/NUMBER OF SCENARIOS

Section 2.1.1 of the Report of the CIA Task Force on Segregated Fund Investment Guarantees (March 2002) offers the following:

> "To offer some guidance as to the number of scenarios that need to be generated, recall that the standard error of the result can be expressed as a function of the square root of the number of observations. To increase the precision of the policy liability calculations, it may be necessary to significantly increase the number of scenarios.
>
> The number of scenarios would be at least 1,000. The appropriate number will depend on how the scenarios will be used (e.g., calculating percentiles will generally require more scenarios than calculating expected values), and the materiality of the results. The actuary would test that the number of scenarios used provides an acceptable level of precision."

The actuary may regularly perform "off-cycle" valuations using a larger number of scenarios than the minimum of 1,000 indicated above but, due to time constraints in the financial reporting cycle, use a lower number of scenarios for valuation in "real time." The actuary would perform testing to ensure that the smaller sample chosen is representative within an acceptable level of materiality.

The actuary would also be aware that events, such as policyholders exercising of reset options, can cause the ordering of the scenarios to change. This would suggest that the smaller sample of scenarios to be used would be retested from time to time.

APPENDIX A

BIFURCATED VERSUS WHOLE CONTRACT APPROACH

The following examples show how the policy liability might be expected to react under different market conditions under the two approaches to valuation.

Description

Assume that a cohort of variable annuity policies has been issued with an initial AAE of $1,000. The policies were priced with 100 basis points of expected revenue. There are no guarantees. A second cohort of policies has been issued with the same initial AAE of $1,000 but with a 10-year maturity guarantee for which an additional 50 basis points has been charged.

Under the Bifurcated Approach recoverability testing for the AAE is done assuming 100 basis points of revenue. The liability for the guarantee is calculated assuming 50 basis points of revenue. This allocation does not change from period to period. If the AAE becomes unrecoverable, it is written down to the level where it is recoverable and the future amortization schedule reduced proportionately.

Under the Whole Contract Approach the entire 150 basis points of revenue would first be made available to test the recoverability the AAE. If the 150 basis points become inadequate to recover the AAE, the AAE would be written down to the level where it is recoverable and the future amortization schedule would be reduced proportionately. Consistent with the description in Section 2 of this note, the total liability would then be calculated using 150 basis points of revenue and the liability for the guarantee would be obtained by subtracting the negative AAE balance from this liability. This approach results in an implicit split of the revenue between AAE recoverability and the liability for the guarantee, and this split may change from period to period.

Consistent with paragraph 2320.24 of the Standards of Practice, under both approaches once the AAE is written down it may not be written back up.

Example 1

In this example, under the scenario being tested, the liability for the guarantee remains positive under both approaches. The example moves through various states reflecting market movements which, in turn, affect recoverability and the level of the liability for the guarantee.

For simplicity, it is assumed that the AAE remains constant except for situations in which a write-down is required.

State 1 – Initial

When this cohort is issued, 90 basis of revenue is required to amortize the AAE.

State 1	No Guarantee		With Guarantee	
			Bifurcated	Whole Contract
AAE	(1,000)		(1,000)	(1,000)
Basis points allocated to guarantee	N/A		50	60
Liability for guarantee	N/A		116	4
Total liability	(1,000)		(884)	(996)

The Whole Contract Approach produces a lower liability because all revenue is reflected.

State 2 – Modest Market Correction of 3%

The AAE now requires 93 basis points of revenue for recoverability. It is, therefore, still recoverable under the Bifurcated Approach. Under the Whole Contract Approach, 93 basis points are first allocated to the AAE leaving 57 basis points for the guarantee.

State 2	No Guarantee		With Guarantee	
			Bifurcated	Whole Contract
AAE	(1,000)		(1,000)	(1,000)
Basis points allocated to guarantee	N/A		50	57
Liability for guarantee	N/A		466	388
Total liability	(1,000)		(534)	(612)
Change in liability from previous state	0		350	384

The change in the liability for the guarantee is larger with the Whole Contract approach because revenue must be shifted to recover the AAE.

State 3 – More Severe Market Correction of 15%

In this state, the AAE now requires 106 basis points of revenue for recoverability. Under the Bifurcated Approach, this is higher than the 100 basis point allocation so the AAE must be written down to a recoverable level. Under the Whole Contract Approach, the total revenue of 150 basis points is still sufficient. The AAE is, therefore, not written down, but less revenue is now available for the guarantee.

State 3	No Guarantee	With Guarantee	
		Bifurcated	Whole Contract
AAE	(944)	(944)	(1,000)
Basis points allocated to guarantee	N/A	50	44
Liability for guarantee	N/A	1,865	1,921
Total liability	(944)	921	921
Change in liability from previous state	56	1,455	1,533

As there is now no "idle" revenue under the Bifurcated Approach, all revenue is now being captured under both approaches and the same total liability results. In practice, this may not precisely result because of the different implicit allocation of revenue between the AAE recoverability and the guarantee.

State 4 – Most Severe Market Correction of 42%:

In this state the original AAE of $1,000 now requires 155 basis points of revenue for recoverability. Under the Whole Contract Approach the AAE must now be written down because the total revenue of 150 basis points is inadequate. All revenue is allocated to the AAE leaving none for the guarantee. Under the Bifurcated Approach the AAE must be written down further, but the allocation to the guarantee remains unchanged.

State 4	No Guarantee	With Guarantee	
		Bifurcated	Whole Contract
AAE	(644)	(644)	(967)
Basis points allocated to guarantee	N/A	50	0
Liability for guarantee	N/A	5,015	5,338
Total liability	(644)	4,371	4,371

As in State 3, the total liability is the same under both approaches since there is now no "idle" revenue under either method.

State 5 – Market Recovery to State 3

In this state the original AAE of $1,000 once again requires 106 basis points of revenue for recoverability. Under both approaches the AAE may not be written up. Under the Bifurcated Approach the allocation of revenue does not change so there is now an excess

margin of recoverability. Under the Whole Contract Approach the total revenue of 150 basis points is now more than adequate so revenue may be directed back to the guarantee.

State 5	No Guarantee	With Guarantee	
		Bifurcated	Whole Contract
AAE	(644)	(644)	(967)
Basis points allocated to guarantee	N/A	50	47
Liability for guarantee	N/A	1866	1894
Total liability	(714)	1,222	927
Change in liability from previous state	0	(3,149)	(3,444)

The change in liabilities is larger under the Whole Contract Approach reflecting the change in allocation of revenue to the guarantee.

Example 2

In this example, the calculated liability for the guarantees is initially negative and so the effect of imposition of a zero floor comes into play. Again, the example moves through various states reflecting market movements which in turn affect recoverability and the level of the liability for the guarantee.

For simplicity it is assumed that the AAE remains constant.

State 1 – Initial

When this cohort is issued, 90 basis of revenue is required to amortize the AAE.

State 1	No Guarantee	With Guarantee	
		Bifurcated	Whole Contract
AAE	(1,000)	(1,000)	(1,000)
Basis points allocated to guarantee	N/A	50	60
Liability for guarantee	N/A	(556)	(667)
Liability for guarantee after floor	N/A	0	0
Total liability	(1,000)	(1,000)	(1,000)

Since the calculated liability for the guarantee is negative under both approaches, the effect of the zero floor is that the booked liability is the same.

State 2 – Modest Market Correction of 3%

The AAE now requires 93 basis points of revenue for recoverability. Therefore, it is still recoverable under the Bifurcated Approach. Under the Whole Contract Approach, 93 basis points are first allocated to the AAE leaving 57 basis points for the guarantee.

State 2	No Guarantee	With Guarantee	
		Bifurcated	Whole Contract
AAE	(1,000)	(1,000)	(1,000)
Basis points allocated to guarantee	N/A	50	57
Liability for guarantee	N/A	(456)	(534)
Liability for guarantee after floor	N/A	0	0
Total liability	(1,000)	(1,000)	(1,000)
Change in liability from previous state	0	0	0

The change in the calculated liability for the guarantees is larger under the Whole Contract Approach. However since this calculated liability has remained negative under both approaches, the effect of the zero floor is that the booked liability is the same.

State 3 – Further Severe Market Correction – total of 7%

In this state, the AAE now requires 97 basis points of revenue for recoverability. Under the Bifurcated Approach it is, therefore, still recoverable. However, the market movement results in the liability for the guarantee becoming positive. Under the Whole Contract Approach the calculated liability for the guarantee remains negative so the zero floor is still in play.

State 3	No Guarantee	With Guarantee	
		Bifurcated	Whole Contract
AAE	(1,000)	(1,000)	(1,000)
Basis points allocated to guarantee	N/A	50	53
Liability for guarantee	N/A	11	(23)
Liability for guarantee after floor	N/A	11	0
Total liability	(1,000)	(989)	(1,000)
Change in liability from previous state	0	11	0

The Whole Contract Approach provides a more stable liability because the calculated liability for the guarantee remains negative for a longer period.

In the event of a more severe correction with the liability becoming positive, the patterns of Example 1 will appear. Market movement will tend to have a more exaggerated effect on the Whole Contract liability because there will be a shift in revenue allocation. This effect occurs only when the liability for the guarantee is positive.