

**ACTUARIAL SOCIETY OF INDIA**  
**EXAMINATION**

May 2006

**Subject ST2 — Life Insurance**  
**Specialist Technical**

**MARKING SCHEDULE**

**1** Underwriting assists the life insurance company in managing risk in the following ways:

It assists the company in identifying those lives whose mortality and morbidity risk is so seriously impaired that the life insurance company should decline the application for insurance.

It assists the company in identifying those lives who present 'above average' mortality or morbidity risk to the insurance company and who should be charged extra for the additional risk that they present.

Underwriting may also assist the company in identifying the type of additional charge that is appropriate for these sub-standard lives e.g. rating the life on an age+x years basis and charging a premium accordingly or adding a fixed amount to the mortality rate for a limited number of years, depending on the nature of the additional risk that the proposer presents to the insurance company.

Adequate risk classification during the underwriting process helps to ensure that all proposers are treated equitably and charged an appropriate premium commensurate with the risk they present to the company.

Underwriting helps to ensure that the actual mortality and morbidity experienced by the life insurance company is in line with that anticipated in the pricing basis of the contracts in question.....

.....And if it is found through mortality investigations that the mortality experience is deviating away from the pricing basis then alterations can be made to the underwriting procedures to address this.

Financial underwriting, which involves the assessment of the amount of insurance requested against the financial need for insurance (e.g. through looking at salary details of the proposer, the number of dependents and so on), helps to reduce anti-selection risk, where a proposer requests too much insurance that is out of line with their financial needs.

Underwriting can be used to facilitate enhanced annuity rates to impaired lives.

A form of underwriting can be used at claim stage to verify the legitimacy of the claim having regard to information supplied at application.

[Total 4]

**2** Life insurance companies require capital to demonstrate solvency to regulator bodies.

Capital is also used to demonstrate strength to other institutions such as rating agencies and insurance intermediaries, which helps to secure new business.

Capital protects insurers from the effects of adverse deviations in experience, for example fluctuations on claims experience or unexpected costs.

Most forms of new business require capital in their early years to cover the initial strains from expenses, commission and reserving, since the premiums received in the early years are likely to be insufficient to meet all of these.

Having access to capital or having excess capital may mean that the life insurance company can pursue a more aggressive investment strategy or more aggressive pricing strategies.....

.....However pursuing such a strategy may also lead to increased reserving requirements, especially if a risk based capital approach is used for reserving and may lead to the requirement to set up additional reserves, which will utilise some of the excess capital.

It can also help insurers to retain profits, e.g. an insurer with excess capital is more likely to be able to absorb mortality fluctuations and may therefore have less need for reinsurance – and hence a greater proportion of the profits arising will be retained by the insurer.

For with profits business, capital can be used to smooth bonuses or pay more than asset share at maturity.

The company may also require capital to invest in projects, such as systems projects, which are usually designed to make the processing of the business more efficient and hence lead to enhanced profits in the future.

The company may also require capital to invest in the expansion of the business e.g. through the development of a new sales channel, or expansion of an existing channel or to develop a new suite of products.

Lastly, the company may require excess capital if it engages in merger/acquisition activity e.g. to pay goodwill if a business is being acquired or to pay for one-off costs, such as redundancy costs.

[TOTAL 6]

**3.** Mortality experience may differ for different sales channels because of the different socio-economic/demographic profile that each channel is likely to appeal to, who initiated the sale and the element of death cover included in the contract.

In this case, for unit linked savings contracts sold through a life insurance company's own sales force, mortality may be lighter than for the business sold through the direct marketing channel.

The reason for this is that the sale agents are likely to target lives from higher socio-economic classes, who can afford to pay reasonable sized premiums (since the salesperson's commission is likely to be linked to the size of the premium) and the

primary driver for the policyholder taking out the contract is likely to be the long term savings element rather than death cover (unless the death cover offered is very high in the initial years compared to the premium/unit fund size).

In addition, the salesperson is likely to avoid those cases where there is likely to be significant underwriting or likely problems at the underwriting stage, since he/she may have to get involved in that making it a more difficult sale than one to a more healthy life.

For business sold as a result of mailshots, the mortality experienced will depend on how the mailshots were targeted e.g. particular residential areas, through particular newspapers etc.

Insurance companies usually use mail shots as a cheap way of obtaining business and hence may have aimed the mailshots at a relatively less affluent population than those that would be targeted by their salesforce.

If this is the case, then we may expect mortality to be heavier than for the business from the salesforce.

The additional risk of anti-selection i.e. those lives in relatively poorer health taking up the offer, is small due to the savings nature of the contract on offer – unless the life insurance company has offered some particularly attractive death benefit features/waived some underwriting on these policies e.g. due to the likely lower average case size.

Those policyholders who were sold their policies through the salesforce channel may be more likely to have been put under pressure to purchase the policy and hence they may be more likely to lapse the policy especially during the early years of the policy.

However, the policyholders who purchased through the sales force may be more financially sophisticated than those who purchased through the direct marketing route, may have a better understanding of the product they bought (since it should have been explained at point of sale by the sales person) and hence may be less likely to lapse than the direct marketing policyholders since they understand better the financial consequences of doing so (e.g. poor surrender values offer in early years etc).

In addition, the direct marketing policyholders in lower socioeconomic groups may be more likely to be affected by a general downturn in the economy and hence more likely to lapse their policy should that situation arise.

If salesforce provides good service and/or builds strong relationship with clients / get trail commission could improve persistency – but may encourage churning if regulations/controls don't control it

Hence there are a mixture of factors that will determine the lapse experience – it is likely that there will be higher lapses initially from the salesforce business initially, due to forced sales/mis-selling but over longer durations the lapse experience may be

worse for the business secured through direct marketing due to the socio economic status of that policyholder population.

[Note marks to be given for any reasoned argument in either direction!]

[TOTAL 8]

4.

(i) *Unit linked savings – bancassurance – charges*

- ? Allocation rate of premiums to units
- ? Allocation rate varying over time
- ? Bid-offer spread – difference between the price at which the company sells the units and the price at which it will buy them back at a point in time
- ? Fixed amount deducted from each premium paid
- ? Amount deducted from each premium paid but linked to an inflation index.
- ? A percentage of fund charge
- ? A percentage of fund charge varying with unit types – typically a special type of unit purchased by premiums paid at early durations with a higher percentage of fund charge than units purchased at later durations
- ? A regular fixed charge met by cashing units irrespective of whether premiums are paid
- ? As above but the charge linked to an inflation index
- ? A cost of insurance charge incorporating margins greater than the likely cost of insurance
- ? A charge related to the sum insured but not intended to be related to the cost of insurance – possibly varying over time
- ? A deduction from payments that would otherwise be made on surrender – often on a sliding scale and reducing to zero after a number of years.

(ii) *Factors to be taken into account in charging structures to recoup initial expenses*

- ? Level of expenses – if initial expenses are relatively low, a charging structure that is aligned with the incidence of expenses is more likely to be acceptable than if they were high.
- ? Marketability – the alternatives impact the marketability of the product as they create different perceptions in consumers minds; reduced allocation rates that match the incidence of initial expenses are often perceived as unattractive even though their incorporation may result in better long term benefits than would otherwise be the case.
- ? Marketability – the relevance of sales illustrations in the sales process which may be used to shift emphasis towards the long term benefits.
- ? Marketability – the bank will want to ensure that the product design reinforces the bank's brand including relative emphasis on short and long term value for money, transparency and treating customers fairly.
- ? Marketability – the design of the product and the complexity of the charging structure needs to reflect the skills of the sales people and they also need to be comfortable with the product design.
- ? Financial efficiency – charging structures that are explicitly aligned with initial expenses (reduced allocation rates) or implicitly aligned (actuarial

funding or the ability to establish negative non unit reserves) result on lower capital requirements or greater capital efficiency with capital being released more quickly – an advantage if absolute capital availability is limited but a disadvantage is capital is readily available and attractive capital deployment opportunities are being sought.

- ? Administrative complexity – the capacity of the administrative system might constrain the charging structure.

[Total 11]

5. [i]

The factors that are likely to have influenced why the term assurance business was so heavily reinsured at outset are as follows:

*Lack of past experience on which to base pricing assumptions*

When the company commenced operations 10 years ago, it would have had no prior term assurance experience on which to base its pricing assumptions and, given that the company was totally new at the time, it had no experience of writing any type of business in the market, and hence couldn't base the mortality assumption on an alternative line of business.

The company could have used data available in the market place, such as published mortality tables or population tables, but it is likely to have sought a more robust approach through using reinsurers already operating in the market to provide assistance in setting the mortality assumption to be used in the pricing basis.

*Ability to offer competitive premiums*

Term assurance is a particularly price sensitive contract and in order to sell sufficient volumes of this business it is likely that the life insurance company would have to be able to offer premium rates that are competitive with the rest of the market.

In order to be able to do this with some degree of certainty that the pricing basis is reasonable, the insurer may need the assistance of a reinsurer.

*Lack of experience in underwriting and the need for technical assistance*

A new insurance company would not have any established underwriting procedures and a reason why the business was so heavily reinsured 10 years ago may have been to gain technical assistance from the reinsurers in terms of producing an underwriting manual suitable for use in the market in question and the provision of training for underwriters.

Even if experienced underwriters were hired from other companies at the outset of the business, the products offered, the sales channels used and the market segments targeted may all have necessitated a different approach to underwriting to what they had used in the past.

Similarly, even if one of the promoters of the new company 10 years ago as an experienced multi-national insurer, their experience in other markets overseas is not likely to be relevant in a new market.

*The life insurance company's risk appetite and access to capital*

Generally an insurer will reinsure less/retain more business, the greater its appetite for risk and the greater its access to capital.

Hence a company with a very healthy solvency position may choose to reinsure less because it can absorb mortality fluctuations within its free asset ratio.

A new company is likely to have limited capital and have many uses for that capital, such as establishing new sales channels and so on, and hence is likely to want to keep reserving requirements to a minimum. Reinsurance may facilitate this.

In addition, if the company is part of a multi-national group of companies, the company's appetite for risk may be heavily influenced by the approach to risk within the group as a whole.

*Local regulations*

The local statutory regulations may have influenced the amount of business that was reinsured.

This may have been direct influence due to prescriptive regulations e.g. the regulations may state that if an insurer doesn't have experience a fixed percentage of the business has to be reinsured, or indirectly, e.g. it may have been advantageous from a capital management perspective to reinsure a large proportion of the business, due to the treatment of reinsured business in the local statutory valuation regulations.

These factors may have influenced this insurer to heavily reinsure their term assurance portfolio 10 years ago.

[ii]

The Director's suggestion may have arisen due to the fact that he/she believes the term assurance book to be profitable.....

.....and that in reinsuring such a large proportion of the term assurance business, profits are being given away to the reinsurer.

In order to determine whether to reduce the amount of reinsurance on the term book of business, the following factors would need to be considered:

- ? The mortality experience of the in-force book of business and whether this has been significantly lighter than anticipated in the pricing basis

If the mortality experience has been favourable and lighter than anticipated in the pricing basis then there is merit in considering reducing the amount of business ceded to the reinsurer.

- ? The size of the book of term assurance business, the relative size of the mortality fluctuations/ the stability of the mortality experience over time.  
If the book of term business is relatively large and the mortality experience does not vary significantly from year to year then the insurer can consider reducing the amount of business it cedes to the reinsurer.  
Conversely, if the term assurance book is still relatively small (and hence the experience is not significant) or if the claims fluctuations from year to year are significant then the insurer must consider carefully other factors, such as the insurers solvency position, its attitude to risk and so on before it reduces the amount of business reinsured.  
This is because if the insurer were to reinsure less, and there were significant claims fluctuations, the insurer must be certain it can meet these claims fluctuations, without it weakening significantly the insurer's solvency position.  
In addition, for some insurers, especially if they are listed companies, the stock market/market analysts will be looking for very steady results each year and for this reason the insurer may not want to reinsure less.
- ? The terms on which the reinsurance has been secured from the reinsurer.  
The business may have been reinsured on very good terms with the reinsurer, such that the insurer actually makes a greater profit from having a larger proportion of the book reinsured.  
Whilst this is unlikely to be a sustainable position in the long term, it is something that the insurer is likely to want to take advantage of for as long as possible and would therefore mean that the Director's suggestion would not be taken up.
- ? Any other reinsurance that the insurer has or could put in place to limit its exposure to large mortality fluctuations caused by large one-off claims or groups of claims  
e.g. the insurer may have/could put in place some excess of loss or catastrophe cover to limit such mortality fluctuations  
This is likely to be a cheaper option than continuing to cede such a large proportion of its business to the reinsurer and would be likely to result in the insurer retaining a greater proportion of the profits arising on this business, whilst protecting the reinsurer from the risk of poor results due to large one-off claims.
- ? The impact that changing the treaty may have on the amount of technical assistance that the reinsurer will offer e.g. underwriting training.  
Given that the insurer has been writing this business for 10 years, this is unlikely to be a major concern, since it is likely to have built up a



- skilled underwriting team – plus other reinsurers may offer help if the current one withdraws assistance, in an attempt to win some business.
- ? The impact that changing the term assurance treaty may have on the reinsurance arrangement for other lines of business.  
e.g. if the profitable term assurance treaty is subsidising another loss making treaty that the reinsurer has with the insurer, reducing the amount of term business ceded may lead to the reinsurer looking to renegotiate the terms on other treaties.  
The extent to which this will influence the decision on the amount of business ceded under the term assurance treaty, will depend on how much other business is ceded to the same reinsurer, and what the net result on the insurers profits are likely to be if all reinsurance treaties are renegotiated.

Overall, it is likely that the Director's suggestion is a sensible one for the actuarial team to consider.

As discussed above, other actions may be necessary to protect the insurer's results from wide fluctuations if it chooses to reinsure significantly less business e.g. putting in place some excess of loss cover.

In addition, the actuarial team would have to ensure the Board of Director understood the potential impact on the company's results/solvency position of taking the action suggested.

[Total 12]

6. a

*Risks – policy administration systems*

Data for actuarial investigations of various types is drawn from policy administration systems. Inaccurate data implies inaccurate actuarial conclusions.

Supervisory reserves and / or financial / embedded value reporting may be inaccurate, which could result in a compliance breach, regulatory intervention and undetected looming insolvency. loss of market confidence and inappropriate rewards to senior managers and others.

Internal capital adequacy assessments may be inaccurate resulting in regulatory intervention, rating agency issues, misallocation of shareholder capital and inadequately priced risks.

The inaccurate data may lead to inappropriate surplus distributions to participating policyholders, which could create costly PRE for the future.

Product pricing may be based on flawed assumptions derived from flawed data, resulting in contracts being under-priced (and therefore loss making) and or overpriced (and therefore difficult to sell).

Commission payment arrangements with intermediaries could be compromised resulting in loss of support from intermediaries.

*Economic environment*

The economic environment has a pervasive impact on experience, which may depart from the experience anticipated when the products were priced, when establishing reserves and when framing operational plans generally.

The significance of a change in economic environment will depend not only on the extent of the change in the economic scenario but also the ability of the insurer to adjust pricing, adjust reserves by calling on additional financial resources and varying plans by applying control cycle principles.

If investment earnings are less than expected then they may be inadequate to support guarantees and exposures to asset / liability mismatching may 'bite'.

In addition, sources of revenue linked to investment performance e.g. assets under management charges, will be less than expected, which may have a knock-on effect on bonus levels that can be declared and on PRE.

Higher levels of inflation than expected results in higher than expected expenses. This will impact the current financial performance, the embedded value of the insurer would be degraded and capital adequacy impaired if inflation levels are higher than previously anticipated and continue with little or no control cycle ability to respond.

Economic environment could impact sales and persistency.

*Level of new business*

New business can have both positive and negative impacts on a life insurer and the net impact is highly contextual.

High levels of new business may be positive – market perceptions of the company will be improved, it will increase the morale within the company, it will generally be value adding subject particularly to pricing, and may result in reduced unit costs both immediately and in the longer term and will generally increase the risk bearing capacity.

However high new business may also be negative for the insurer, especially if it is a signal of business having been under-priced, with additional capital required to finance reserves and capital adequacy margins, and pressures on administration processes and resources e.g. on skilled underwriters.

The positive and negative sides of low levels of new business are typically the mirror image of the impact of high levels of new business.

*[ii] Actions that can be taken to limit risks*

*Risks – policy administration systems*

Data reconciliation – reconciliation of current data with that used for the preceding investigation. An analysis of the product movements in number of contracts, sum insured, office premiums, attaching bonuses, units allocated could all be considered.

Consistency – average sum insured and premium for each product type should be sensible and consistent with that used in the previous investigation; ratio of sum insured to premium should be sensible and consistent with that used in the previous investigation.

Unusual values and spot checks – e.g. very large premiums, sums assured, claims or zero values under unutilised contracts; impossible dates of birth or start dates. Also consider implausible clustering of, say, birth months.

Analysis of surplus or embedded value profit – a major discrepancy in the analysis compared to previous analyses may indicate a problem with data.

Increase controls over data collection/input and implement internal audit reviews

### *Economic Environment*

Investment earnings – product design generally but particularly the extent of financial guarantees can be limited to reduce the risk of the impact of a downturn in the economic cycle; investment linked business generally transfers investment risk towards policyholders; with profits business also transfers risk but extent is dependent upon premium rates which inevitably incorporate some guarantee and nature of bonus method.

Investment earnings – investment policy, particularly the extent to which investment policy is aligned to product guarantees directly or indirectly by the use of derivatives; and the alignment of the investment policy with PRE are ways to reduce the impact of a downturn in investment earnings.

Inflation – product design generally but particularly linking charges and / or premium rates to prevailing inflation rates; containment of expenses within policy loadings built into premium rates and charges; compare expense performance with competitors; and analysing expense experience generally.

Control cycle – analysing experience regularly and reflecting experience in revised product related determinations – pricing and bonus distributions.

### *Level of New Business*

General aim is to manage new business towards an optimal level as opposed to maximise.

Increase new business – increase commissions, reduce prices generally, increase minimum policy sizes, develop new products, access new distribution channels.

Options can only be assessed properly with an assessment of the marginal impact of the option concerned on the company's performance taking account especially fixed versus variable costs.

Reduce new business - the converse of the above but taking account of the driver of the need to reduce e.g. administrative pressures or capital demands and the way these vary by product type.

Reducing new business generally has a significant strategic risk for most companies and alternative options such as alleviating pressures by varying the new business mix should be explored.

[Total 12]

7. [i] The main risks to the company in launching an impaired life annuity product are as follows:

*Mortality risk*

Mortality risk, and in particular longevity risk, is the main risk to the company when offering this contract.

The risk is that more impaired life annuitants will live longer than is assumed in the pricing basis....

...meaning that the company will have to make annuity payments for a longer period of time than it expects to a larger number of annuitants than it expects.

*Investment risk*

If the company overestimates the mortality for the impaired life annuitants, and the annuitants live longer than expected, then there is a risk that the company will invest in assets that produce an income for too short a duration to match the liability outgo.

*Moral hazard/Product risk*

The company must consider whether other insurance providers in the market offer a similar product or whether this is the first impaired annuity to be offered in the market in question.

If the company reduces its rates for non-impaired lives then annuitants may select against the company to get better rates elsewhere.

If the company is the first to offer an impaired life annuity, then there is a significant risk of moral hazard occurring if the annuity-purchasing public understand the impaired life annuity product being offered.

Potential purchasers may lie about their smoking status, for example, on application forms to meet the eligibility criteria.

If this occurs, and the insurance company does not vet the applications properly, then it may be that ordinary lives are accepted on impaired life annuity terms, which would result in a loss to the insurance company, since the impaired life annuitant population is then likely to live for longer than expected in the pricing basis.

*Mortality improvement/Experience risk on ordinary life portfolio*

The company's current ordinary life immediate annuitants are likely to contain a mixture of impaired and unimpaired lives.

This means that the average mortality experienced by this portfolio of lives will be worse than a portfolio where all the impaired lives are removed.

If the company offers the impaired life annuity, there is a danger that in future the mortality experience of the ordinary life annuitants is lighter than allowed for in the pricing basis and lighter than has been the case in the past.

*Marketing/reputation risk*

If the company is the first to offer an impaired life annuity in the market, then there is a marketing risk in that the company may suffer from poor publicity either as a result of the perception that the insurer is trying to make profits out of annuitants in poor health, or due to the risk that the processing of the new product does not go as smoothly as expected (e.g. due to the underwriting process taking too long).

[ii] The main actions that the insurer can take to minimise these risks are as follows:

*Longevity risk*

The insurer must ensure that it introduces an adequate underwriting procedure to determine whether a life is eligible for the impaired life annuity.

This will involve adding appropriate questions to the proposal form regarding the proposer's health and lifestyle. e.g. height/weight/BMI questions, smoker status as well as quantity of cigars/cigarettes smoked, alcohol consumption and so on.

Care will be taken over the smoker status, since someone who smokes only occasionally may classify themselves as a smoker, when their mortality risk is very similar to a non-smoker.

Hence the amount of smoking in the last x years may be assessed to determine whether a proposer is classed as a smoker or not.

The questions asked on the proposal form may be quite similar to those used to assess term assurance applications, since the underwriter is likely to be looking for the same indicators of poor health.

The underwriting procedure is also likely to involve some second stage testing to ascertain whether the proposer can be accepted on impaired life terms.

For example, the proposer may be required to undergo medical tests to assess heart function and general levels of fitness.

The underwriter would be looking for those test results to show that the proposer was in poor health.

In addition, the insurer can also be relatively conservative in the way it sets the mortality assumption for the impaired life annuities and ensure that it does not overestimate the mortality assumption for impaired life annuitants.

Whilst a heavier mortality assumption than for the ordinary lives will be chosen, it may be set such that it is not significantly heavier than the ordinary lives assumption or so that it allows for greater improvements in mortality in the future.

The insurer may seek the advice of its reinsurers to assist in setting the impaired life annuity mortality assumption, since the reinsurers may have experience of writing such business either in this market or in other markets overseas.

The insurer may reinsure a proportion of the impaired annuity business, which will also assist in minimising the longevity risk that the insurer is exposed to.

The insurer may also use any publicly available annuitant mortality tables that differentiate between, say, smokers and non-smokers to assist in setting the mortality assumption.

The moral hazard risk is best controlled by a strict underwriting process as outlined above.

The risk of improvements in the mortality of the ordinary lives portfolio is best dealt with by careful monitoring of the mortality experience on that book of business and ensuring that adequate provision has been made for future improvements in mortality in the pricing basis.

The marketing/reputation risk will be minimised by ensuring that the company adequately thinks through the underwriting and administration processes in advance of launching the contract, and makes whatever system changes are necessary to the policy administration system so that the business can be processed adequately.

Staff, and in particular underwriters, must be trained in advance of the launch of the product so that the underwriting process is smooth.

The marketing material accompanying the product launch and the information given to the sales channels must provide adequate detail related to the underwriting procedure so that they can clearly articulate to proposers why it is necessary.

The company may consider adding further features to the contract, e.g. ensuring the annuity payment is made for a minimum of 2 years, to minimise the poor publicity that might arise were lots of impaired life annuitants to die soon after the inception of their policies.

[Total 14]

8.

[i]

*[a] Gross Premium Valuation Method*

The gross premium valuation method is a method for placing a value on a life insurance company's liabilities that explicitly values the future office premiums payable.

It usually values expenses explicitly.

It may allow for benefits payable on lapse or surrender.

It may include future discretionary benefits.

*[b] Unit Reserve*

This is part of the reserve that a life insurance company needs to set up in respect of its unitised contracts. The unit reserve represents its liability in terms of units under the contract.

*[c] Non-unit Reserve*

A company may have non-unit liabilities under its unitised contracts - for example the expenses of managing the business....

....for which it receives monetary payments in the form of future charges it extracts.

If it expects that the charges will not be sufficient to meet these liabilities at any point on a cash flow basis, and there are insufficient profits emerging before that point, it has to hold a non-unit reserve to provide for the deficiency.

It may be possible for a life insurance company to hold a negative non-unit reserve where it expects that future unit charges will be more than sufficient to meet the future non-unit liabilities.

*[ii] GPV Elements*

- ? Interest earnings
- ? Mortality
- ? Morbidity and other types of claim rate
- ? Lapses
- ? Surrenders
- ? Exercise of options
- ? Maintenance expenses
- ? Claim related expenses
- ? Inflation
- ? Premium persistency
- ? Non forfeiture options
- ? Tax
- ? Shareholder dividends
- ? PRE.
- ? Variations of the above over time.

*[iii] Non-unit Reserve Determination*

1. Project the expected future cash flow from the policy, ie income from charges less outgo.
2. Identify the last (most distant) negative cash flow (say this occurs at time  $t$ ).
3. Set the reserve as the amount needed to meet that cash flow at that point in time
4. Move back to the previous cash flow (ie to time  $t-1$ ). Discount the reserve from time  $t$  to time  $t-1$ , and then subtract from the reserve the new cashflow at time  $t-1$ . If the reserve becomes negative then set the reserve to zero.
5. Carry on repeating the process working backwards in time through times  $t-2$ ,  $t-3$ , etc until you reach the present (valuation) date time 0.

*[iv] When Non-unit Negative Reserves may be used*

Most likely to be possible when heavy initial expenses are recouped over time by some form of 'back-end' charge.

Examples:

- ? A percentage of future premiums,
- ? A percentage of ongoing sum insured,
- ? A higher than normal assets under management related charge,
- ? A surrender penalty, or
- ? Additional margins incorporated into a cost of insurance charge.

To a greater or lesser extent under such designs, there will be a large negative cash flow in the first policy year followed by excess positive cash flows in future years.

Negative non unit reserves can then be used to deduct from the liabilities the expected present value of these future positive cash flows, that is for the future contributions to the initial expenses that the company expects to receive.

The deduction is limited to the surrender penalty.

*[v] Significance of negative non-unit reserves to shareholders*

They will reduce the total reserve under a contract.

This will improve the capital efficiency of the product as well as the overall capital required to be invested in the company.

including the capital required to establish solvency margins where these themselves are related to reserves.

*[vi] Conditions attaching to allowing negative reserves*

1. Total reserves exceed surrender value – this ensures that the company is holding enough money if the policy surrenders.
2. After taking account of the negative non unit reserves, there are no future negative cash flows for the policy – thereby ensuring that the insurer is holding enough money if the policy stays to maturity.
3. There are enough positive non-unit reserves held by the company from which to 'deduct' the negative non unit reserves.
4. Note that these could be from anywhere else in the company's business – not just from unit-linked policies.



5. However, it is not right to deduct the negative reserves from the unit funds; this would leave the unit funds seriously mismatched with the assets and would lead to significant investment risk for the company.

[vii] Adjustments to method used to determine Non-unit negative reserves

Standard Method	Negatives allowed
1. Project the expected future cash flow from the policy, ie income from charges less outgo.	Project the expected future cash flow from the policy, ie income from charges less outgo.
2. Identify the last (most distant) cash flow (say this occurs at time t).	Identify the last (most distant) cash flow (whether positive or negative)
3. Set the reserve as the amount needed to meet that cash flow at that point in time	Set the reserve as the amount needed to meet that cash flow at that point in time (even if the cash flow is positive set the non-unit reserve as a negative amount).
4.	Check that the total reserve (ie unit plus non-unit) is greater than the surrender value (ie unit reserve less surrender penalty).
5. Move back to the previous cash flow (ie to time $t - 1$ ). Discount the reserve from time t to time $t - 1$ , and then subtract from the reserve the new cashflow at time $t - 1$ . If the reserve becomes negative then set the reserve to zero.	Move back to the next previous cash flow, discount the reserve and then subtract from the reserve the next cash flow at the earlier time period. Repeat step 4.
6. Carry on repeating the process working backwards in time through times $t - 2$ , $t - 3$ , etc until you reach the present (valuation) date time 0.	Carry on repeating the process working backwards over time to the valuation date.
7. This will give the required non unit reserve at the valuation date.	This will give the required non unit reserve.

[Total 33]

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