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MANAGEMENT OF ASSETS IN RELATION TO LIABILITIES

Moderator: JAMES A. ATTWOOD. Panelists: PAUL KOLKMAN, DANIEL J. MC CARTHY, TERRENCE M. OWENS

A report from the C-3 Risk Task Force.

1. Design of investment strategies to develop cash flow patterns appropriate with the liabilities.

2. Structuring the company to assure that investment returns are channeled to appropriate lines of business.

3. Valuing liabilities to appropriately recognize the relationship between assets and liabilities.

4. Should the actuary be concerned with certification of assets as well as liabilities?

5. Equity among lines contributing to investable cash flow.

Three Discussion Notes follow this digest of the panel discussion:

"C-3 Risk for Non-Par Individual Life Insurance - Results of Additional Tests", by James A. Geyer and Diane L. Arndt.

"C-3 Risk for Participating Whole Life", by Terrence M. Owens.

"Preliminary C-3 Risk Calculations for Individual Deferred Annuities", by James E. Feldman and Paul F. Kolkman.

Reference is also made in this panel discussion to three previous sessions at Society of Actuaries meetings on C-3 risk and related topics:

"Discussion of the Preliminary Report of the Committee on Valuation and Related Problems," 1979 New Orleans meeting, Record 5:1, pp 241-284.

"The Impact of Inflation on Insurance and Annuity Reserve Valuation : The C-3 Risk", 1981 Atlanta meeting, Record 7:4, pp 1349-1391.

"The Financial Risk to Life Insurance Companies from Changes in Interest Rates",1982 Houston meeting, Record 8:1, pp 23-78.

MR. JAMES A. ATTWOOD: This is the panel discussion on "Management of Assets in Relation to Liabilities." My name is Jim Attwood and I will be serving as moderator for this session. As the Chief Investment Officer for The Equitable, the management of assets in relation to liabilities is of particular and immediate concern to me, and the importance of the role that actuaries are playing, and will be called on to play, in this area is especially apparent.

Joining me on the panel this morning are Dan McCarthy, from Milliman and Robertson's New York office, Terrence Owens, from New England Mutual Life in Boston, and Paul Kolkman, from IDS Life in Minneapolis. All three panelists are members of the Society of Actuaries Task Force to Study the Risk of Loss from Changes in Interest Rates, the so-called C-3 Risk Task Force, and you will note in the program that this session is subtitled "A report from the C-3 Risk Task Force." Our recorder this morning, Carl Ohman, also from Equitable, is chairman of the C-3 Risk Task Force.

Inflation, unstable and volatile financial markets, high and changing interest rates, changing as we have seen in the past few months downward as well as upward, have characterized the economic environment of the past three years. The conditions of volatility in change are likely to continue in the future. There is no doubt that traditional insurance and annuity products have become substantially more interest-rate-sensitive, and the risk of disintermediation and, yes, even the risk of intermediation, has become a reality. Insurance and pension customers have become more sophisticated; there is increased competition for savings dollars from outside the life insurance industry; and there is greater and greater need for companies to be "on the market" with current rates of return on terms that meet the current investment needs of our customers.

How do insurance company managers respond to these challenges of inflation, unstable financial markets, and changing interest rates? The answer is simple, but for most of us it has taken a long time to really appreciate the simple answer, that we cope: by recognizing the need, more than ever before, that we must manage our assets in relationship to our liabilities.

Managing assets in relationship to liabilities has four important aspects:

1. First, we design insurance and pension annuity products that respond to the investment needs of customers as well as their need for insurance protection or security of income.

2. Secondly, we must design investment strategies that relate to the investment needs of the company's insurance and annuity products.

3. Thirdly, we must structure the company as needed to permit use of different investment strategies for products with different investment needs, and to channel the investment results accordingly.

4. And, lastly, we must understand the valuation of the company's assets and liabilities under conditions of changing interest rates, recognizing that any valuation of liabilities must take into account the cash flow expected from assets held in support of the liabilities and the way in which the assets are valued.

The main topic of the panel today is, of course, the report of the C-3 Risk Task Force, and that has to do with the fourth of these aspects. But, to set the stage and to encourage the discussion, let me briefly cover the other three aspects first.

Product design is, of course, the first step in managing assets in relationship to liabilities. Current trends, which many writers in the business refer to as the "product revolution", include, for example:

- For individual life insurance, the development of products that either capitalize on the current recently high interest rates or attempt to adjust to inflation, and we have heard of indeterminant premium life, universal life, variable life. For those who still prefer level premium whole life, there are moves underway to change non-forfeiture laws to permit the issuing whole life policies without cash values or with cash values adjusted to current market value.

- For annuities, the product revolution has meant an emphasis on accumulation products with multiple investment and payment options, away from the long-term fixed dollar guarantees.

- For pensions, the emphasis is on dedicated portfolios--dedicated to a specific type of investment, in the various forms of pooled separate accounts; dedicated to the investment needs of a specific individual customer, in individual customer separate accounts; dedicated to provide benefit payments for a closed block of retired lives, through the use of non-par annuities or payment schedules with guaranteed rates of interest or dedicated bond portfolios with no specific guarantee of performance.

- For profit-sharing and thrift plan fixed income guaranteed interest accounts, the trend is toward shorter duration guarantees, or various forms of indexed or adjustable interest rate guarantees.

For the second aspect of managing assets in relationship to liabilities, that of designing investment strategies to meet the investment needs of this explosion of insurance and annuity pension products, the operative phrase, to those of us engaged in that management, is "asset and liability matching." This can take various forms:

- For separate accounts which pass all investment results directly to the customers, asset and liability matching, from the standpoint of the insurer, is complete and automatic since the company's liabilities and assets are the same.

- For traditional general account pension contracts where investment income is passed to the customers through IYM interest rates, and where withdrawals are subject to market adjustment, asset and liability matching is nearly complete and nearly automatic, the exception attributable to the impact of any long-term guarantees to retired participants.

- For annuities which permit withdrawal of cash at book value at any time, asset and liability matching could mean investment primarily in short duration assets.

- For annuities without cash values, and for guaranteed interest contracts with fixed maturities, asset and liability matching becomes largely an exercise in matching maturities of bonds and mortgages to the expected amounts and timing of the guaranteed payments.

- For guaranteed interest contracts open to future contributions or with options for plan participants to move funds before the end of the guarantee period, asset and liability matching becomes more complex, requiring a combination of probabilistic techniques. The same is true of individual life insurance with cash values and the newer forms of interest

guarantees with adjustable or indexed rates, but with even greater complexities. Here the state of the art is in its infancy, and although great strides are being made in the models now being developed by some insurers, much more remains to be done.

In order to achieve an acceptable asset and liability matching for a company with products having differing liability structures, management must find a way to identify the assets that are supporting each of the different product types and to facilitate the design of different investment strategies for the different products. In this third aspect, there are a number of approaches.

The traditional approaches include the formation of separate accounts, subsidiaries, or even separate companies to accommodate products with different liability characteristics.

One approach, which is receiving a good bit of attention now, is to retain the concept of one pooled general account for the company, with all the general account assets standing behind all of the liabilities, but to "segment" the general account into several product lines, each with distinct liability characteristics, and each supported by a portfolio of assets acquired from the cash flow of the products in the segment in accordance with an investment strategy appropriate for the products in the segment. My company has segmented its general account in the beginning of 1981, and the results to date have been very satisfying. Time isn't going to permit me this morning to detail this plan, but details may be found in a paper that Carl Ohman and I have been putting together, a draft of which was circulated earlier this year, in late summer. Those who are interested and have not seen the draft can obtain a copy by leaving their name and address with Carl Ohman or contacting him at The Equitable.

Now let us turn to that fourth aspect of this issue: the subject of valuation of a company's liabilities under conditions of changing interest rates, which I regard as an essential part of any meaningful management of assets in relationship to liabilities. And this, of course, has been the subject of extensive research recently in the Society of Actuaries, by the C-3 Risk Task Force and its parent Committee on Valuation and Related Problems. I would like to call upon the three panelists at this time. First, I am going to call upon Dan McCarthy who will review the work of the task force to date and tell you where it stands and where it is heading. Then we will ask Terry Owens and Paul Kolkman to give reports on two important current task force projects. After their presentations, I have a few prepared questions for the panel and others on the task force and then we will be opening it up for questions from the audience.

MR. DANIEL J. McCARTHY: To put in perspective the work of the C-3 Risk Task Force, I think it would be useful to reflect for just a moment on the stages by which a new development or new area of actuarial concentration moves from its infancy to the point where it becomes a part of an actuary's normal working equipment.

It seems to me that there are really four stages in that process. The first stage is the identification of an issue or a new area. The second stage is a program of research to develop a theoretical base and to publish results to get peoples' minds turning and beginning to focus on the specific issues involved. The third state is education, including what you might call consciousness raising -- just throwing the words and ideas around until people

begin to get comfortable with them. The last stage, if needed, is the development of standards of practice, which are sometimes thrust upon the actuarial profession from outside (for example, by regulators), and sometimes developed within the profession (for example, in the United States, by the American Academy of Actuaries in its Recommendations and Interpretations for actuarial practice).

If we think about those four stages and apply them to the issue at hand, I would say that the first stage, the identification process, was largely carried out by the so-called Trowbridge Committee, the Society of Actuaries' Committee on Valuation and Related Problems, which identified the several different areas of risk that we ought to be thinking about in evaluating the adequacy of reserves held by insurance companies. These have become now familiarly known as the C-1, C-2 and C-3 risks. Here, C-1 is the risk of asset default; C-2 is what you might think of as the insurance risk we were all really trained to recognize when our training was complete, the underlying mortality and morbidity risk; and C-3 is the risk arising from changes in the interest rate environment other than the risk of asset default. The report of the Trowbridge Committee, which is extremely useful in terms of this initial identification, appears in the Record for the 1979 New Orleans Society of Actuaries meeting and is a good point of departure for getting up to speed on where things are now.

The C-3 Risk Task Force, formed in early 1981, was asked to undertake stage two of the four, the research stage, and to a certain extent stage three, that of education. In fact, you could say that today's panel is really part of stage three in the sense that we are reporting on results and engaging in a bit of consciousness raising.

We certainly do not believe that the task force has any unique mandate to carry out these functions. Many people in different areas of expertise, and from different companies and firms, have been doing research on this topic, but the C-3 Risk Task Force has not only commissioned research into C-3 risk -- perhaps bludgeoned people into doing the research is a better way of putting it -- but has also taken on responsibility for trying to coordinate and communicate results.

Some of the particular results that have been published, and which again provide useful background, are as follows. First, in the Record for the 1981 Atlanta meeting, there are two extremely useful papers, one by Don Cody describing much of the underlying mathematics of C-3 risk; another by Jim Tilley and his Equitable associates describing a specific approach to measuring C-3 risk and presenting specific results in the area of guaranteed investment contracts. Second, in the Record for the 1982 Houston meeting, earlier this year, there is a paper by Jim Geyer and Mike Mateja describing some initial results of research at the Aetna into C-3 risk in the area of non-par whole life insurance.

It is important to emphasize that the risk we are talking about is really a total company risk, but that in trying to get ones hands on analyzing the risk it is easier first to look at the risk separately for different product lines with different C-3 risk characteristics. That leaves the really tough challenge for a company engaged in several different lines of business of taking the analytical results for each of the separate product lines and putting them together. Fortunately, the result of putting them together will do either of two things -- not change the outcome, or make the outcome

move in the direction of company solvency. That is to say, the total C-3 risk for all product lines combined will be either the sum of the C-3 risks for the separate lines, or something less than the sum, as opposed to something greater. So we don't lose a great deal in this exploratory phase by thinking about C-3 risk in terms of one product line at a time.

The education stage of the task force effort has included both the publication of these research results and talking about the issues at meetings like this. This may ultimately evolve into some kinds of Society seminars, into modifications in the Society's examination syllabus, and perhaps into other activities too far down the road to envision just now.

The C-3 Risk Task Force does have a kind of suicidal mentality in that we are committed to self-destruct, for lack of a better term, sometime in 1983. Presumably, at that point, we will have completed our mandate to carry out and publish a core of underlying research for people to think about. The Society of Actuaries being the committee forming organization that it is, however, it may be expected that other groups will be formed to pick up and do whatever needs to be done next, so the over-all effort to come to grips with C-3 risk will continue. Increasing coordination with the American Academy of Actuaries in the area of standards of practice will certainly be one aspect of this continued effort.

One thing that the task force has been conscious of throughout its existence is a sense of being overtaken by events. Logically, it would be very nice to be able to identify an issue, then do research, then communicate the results and get ourselves educated, and finally develop standards of practice. Unfortunately, the issues that we are considering are so critical to company management, critical in some cases to company solvency, that while we might prefer to proceed on a leisurely path, we cannot expect, for example, regulators, who have very real concerns about company solvency, to sit by and wait while we finish our work at leisure. As a result, we have felt under some considerable pressure to move forward in reporting on results, engaging in public discussion of the results and their implications, and even considering the need for developing standards of practice, all while the research itself is still being done.

In a moment, we will turn to two particular sets of results that we will be discussing today, and which will be published in the Record for this meeting -- results of work by Terry Owens and others at New England Mutual Life on C-3 risk for participating whole life, and work by Jim Feldman and Paul Kolkman at IDS Life on C-3 risk for individual deferred annuities. Some of these results, in effect, simply confirm earlier intuitions. Others we found do not. I will refrain from quoting the Society's motto here, but I do think it has something to do with the kinds of work the task force has been doing, including the work that will be discussed here today.

In addition to the two presentations that you'll be hearing today, there is also some additional work that has been done by Jim Geyer and Diane Arndt and others at the Aetna, elaborating further on the material presented by Jim and Mike Mateja earlier this year in connection with non-par whole life. That paper will also appear in the Record for this meeting.

So, we are beginning to build a reading list of papers on C-3 risk and related topics that should help us all to become more comfortable with the kinds of thinking and evaluating process that goes into determining whether,

in the light of a company's actual assets, the company's reserves are indeed good and sufficient to meet the maturing obligations.

We are now going to hear from Terry Owens who is going to report on some of the tests that have been carried out for a company, a mythical company which has certain (although not all) of the characteristics of The New England Mutual Life, issuing participating whole life insurance.

MR. TERRENCE M. OWENS: C-3 risk involves the problem of asset and liability matching under varying interest environments. The problem is to determine whether the assets behind a block of business on a valuation date will be sufficient to fund the obligations as they mature and to assure statutory solvency while the obligations are maturing.

A method developed to answer this question for guaranteed interest contracts was presented by Jim Tilley at the Atlanta meeting in the fall of 1981. Jim Geyer then extended the methodology to non-par individual whole life insurance and presented his results in Houston in March, 1982. Briefly, the method used for non-par whole life was to project a block of business that had been built up over a twenty year historical period, together with the assets supporting the block of business, over a period of forty years into the future, allowing only prevailing interest rates and cash flows, to the extent that cash flows depend on prevailing interest rates, to vary among projections. The surplus required at the valuation date to maintain statutory solvency over the projection period was considered the measure of the C-3 risk associated with that projection. A variety of future interest rate paths were tested to give some understanding of the possible magnitude and variability of the risk.

To extend the Geyer methodology for non-par whole life to participating whole life, we examined a mix of policies typical of the period 1962 to 1981. Three dividend classes were run, based on 2½%, 3½% and 4% CRVM with 5%, 6% and 8% policy loan rates. Gross premiums were taken from rate books in effect during that period. Commissions and expenses were assumed at current levels. New issues were set at $1 million in the first year and allowed to grow 5% per year during the historical period.

Cash values were set at relatively high levels that were typical in policies of most mutual insurance companies during the period. This contrasts with the minimum cash values assumed in the non-par whole life study which were based on the 1980 amendments to the NAIC Model Standard Non-forfeiture Law. As a result, in this study, little or no gain from surrender was anticipated to offset losses arising from lapse. It was expected, therefore, that the C-3 risk for participating business would be greater than that for non-par business.

Of course, a more obvious contrast with the non-par study was the inclusion of policyholder dividends. A clearly stated dividend policy was central to this study. For this purpose, we used dividend formulas providing for an automatic pass through of developing experience along the lines described by Don Cody in the Discussion Note he presented at the 1982 Society of Actuaries meeting in Orlando (Record 8:2, pp. 697-713) throughout both the historical and projection periods. These dividend formulas are based on IYM and provide for complete pass through of experience to the policyholder. Specific design elements of the dividend formulas include an eighteen year amortization period for excess initial expenses, and a profit charge of ½% of reserves in each year following the amortization period.

Another important assumption was that dividends would be pegged in response to market pressure only when interest rates are stable or rising and exceed a base rate of 8%. No provision was made for recovering amounts pegged by charges to future dividends.

New England Life experience was used to project policy loan levels and lapse rates as functions of duration, new money rate and policy loan rate. The sensitivity of these formulas will be apparent in the examples to be discussed.

Federal income tax calculations assumed a phase one tax position under the 1959 act throughout the twenty year historical period, moving into a phase two negative position under the 1982 Stopgap legislation for each of the forty years of the projection period.

All investment assumptions were taken directly from the non-par study. The average life of new investments was assumed to be 12.2 years in the historical period, 10.8 years in the projection period. The block of par business under study was assumed to be part of a larger corporate entity with the resources available to absorb surplus strain in the historical period, take advantage of negative federal income tax positions, and lend money when needed in accordance with the usual IYM procedures.

We began by studying three interest rate paths which we believed would best illustrate the range of risks developing across the interest rate path spectrum. Scenario one was a flat 15% interest environment, used as a base against which to compare two extreme scenarios. Both of the two extreme interest rate scenarios involve a quick rise from 15% to 25%. Scenario two then remains flat at the 25% level, while scenario three falls quickly from 25% to 4%. Details of the policy loan and lapse assumptions, insurance cash flow, dividends, asset cash flow, net investable cash flow, and surplus required to bring the block of business to maturity under each of these three scenarios are shown in the Discussion Note, copies of which are available at this session and which will be included in the Record for this session.

The flat 25% interest rate path, scenario two, produces a substantial deficit at the end of the projection period, amounting to $10 million. However, the surplus required at the valuation date to cover this eventual deficit is much smaller than might be supposed. Because of the high rate of return on surplus in that scenario, only $95,000 is needed on the valuation date to cover the $10 million deficit at the end of the period.

For scenario three, the critical year for C-3 risk occurs much earlier in the projection than for scenario two. Here the critical year is the fifth year of the projection period. As may be seen from Figure 8 in the Discussion Note, any amount sufficient to cover the expected deficit in the fifth projection year will be ample to provide protection throughout the entire forty year projection period.

While scenarios two and three are useful to illustrate the range of potential C-3 risk, a number of more moderate interest rate scenarios were also studied, a total of nine scenarios in addition to the three already mentioned. Details of all twelve scenarios and the surplus requirements derived from the projections are shown in the Discussion Note. Because of the interplay between dividends and interest rates, the present value of dividends paid is also shown under each scenario.

Of the twelve scenarios tested, only the two catastrophic scenarios (two and three) showed a loss over the sixty year period. Of the twelve, scenario seven (direct fall from 15% to 4%) would appear to be the most profitable for the company, while scenario ten (fall from 15% to 10%) appears most advantageous to the policyholder in terms of present value of dividends. Surplus requirements on the valuation date under the twelve scenarios vary from 1.5% to 3.3% of the reserve on the valuation date-- at 1.5% in all but the two catastrophic scenarios.

The 1.5% surplus requirement in all the ten non-catastrophic scenarios tested is actually a result of the dividend assumptions and generally shows the yet unmatured state of the closed block of the study. I will explain a bit further. No policy contributes to surplus until its eighteenth year; so the block as a whole will not normally reach a positive surplus position until its twenty-sixth year, and a 1.5% deficit on the valuation date (twentieth year) is therefore expected and quite normal. Only surplus requirements over and above the 1.5% level should be considered significant for C-3 risk. It would appear then that a special reserve of 1.8% of reserves would be sufficient to cover the extraordinary interest rate risks associated with scenarios two and three, if it were deemed appropriate to reserve against such extreme possibilities.

Finally, in order to place an absolute ceiling on the C-3 risk should the lapse or loan assumptions used in the study prove too optimistic, the market value of the assets at the end of each year in the projection period was compared to the unloaned cash values available, and a market value deficit table, showing surplus required to cover a 100% cash out, was developed. This table is included at the end of the Discussion Note. Again, only the two catastrophic scenarios show a market value deficit in the sixtieth year. A 4.8% deficit on the valuation date seems normal given the pattern of asset build-up and interest rate history over the historical period; however, the market value deficit is nearly 9% for scenario one, 12% for scenarios two and three. Surplus requirements in the range of 9% to 12% are sobering indeed. However, these levels must be viewed against the likelihood of 100% cash out at the point of maximum vulnerability for which they would be needed. It is reasonable to assume that market value deficits exaggerate the C-3 risk.

In conclusion, this presents only the preliminary results in this study. Lapse and loan experience varies widely from company to company as do dividend philosophy and investment strategy, so it is hard to say to what extent results are specific to the particular block of business used in the study. In addition, since no one seems to be in a position to place probabilities on a set of interest rate scenarios, an easy way for determining C-3 risk for this product may be beyond our grasp.

MR. McCARTHY: By way of transition to the material that Paul Kolkman is going to report on, you might dwell for a moment on Terry's statement near the end that surplus requirements in the range of 9% to 12% of reserves are sobering indeed. You ain't seen nothing yet! I think it is intuitively clear that the size of the risks is going to be greatest when what you might call the hidden surplus, that is the excess of reserve over cash withdrawal value, is at its lowest and the product design either provides for the greatest possible financial anti-selection by the customer, or at least makes the opportunity for that anti-selection more explicit.

Having said that, I have essentially described some of the single premium and flexible premium annuity contracts that are being sold today, and Paul is going to report on some of the research that has been done to analyze the C-3 risk for those kinds of products.

MR. PAUL F. KOLKMAN: Some copies of a draft Discussion Note prepared by Jim Feldman and myself are available at this session. This still represents a draft; the final version of the paper will be included in the Record for this session.

The methodology of the paper is as consistent as we considered possible with the work that has gone before us. We tried to follow what was done by Jim Tilley for guaranteed interest contracts. Where that failed, we tried to use the non-par life methodology developed by Jim Geyer and Mike Mateja. Where the two failed, we went off on our own. In general, we measured results by a reserve adequacy factor, which is the ratio by which reserves have to be increased on the valuation date to assure that the company can mature its obligations over the projected period.

The model we built is quite general and allows for various histories, various investment strategies and various projections, and the results of the tests we have run really pile up. We haven't included all of them in the Discussion Note, and are not even certain that we have included the best. We have constructed a sort of brute force model that produces a lot of results. You have to look at those, try to figure out what they mean, and decide what to display. That may not be the best way to approach this problem.

The sample company that we built up has a ten year historical period, which we felt typical for annuity business, and we used fifteen year projection periods, which we also felt was adequate for annuity business. We ran each projection over ten distinct interest rate scenarios through the projection period.

We studied two different product types: non-qualified single premium deferred annuities and qualified flexible premium annuities. Both were no load with surrender charges; detailed product assumptions are listed in the Discussion Note.

There are two assumptions that are critical in studying C-3 risk for a product: the asset structure and the surrender formula.

As we built up our company through the historical period, we developed an asset structure based on five asset types: (1) one year bonds; (2) three year bonds; (3) level sinking fund seven year bonds; (4) fifteen year bonds with level sinking fund payments beginning in the sixth and going through the fifteenth year; and (5) twenty year bonds. The investment mix among these five asset types evolved over the ten year historical period, with 80% of cash flow going into twenty year bonds in the first year of the historical period, tending to no money going into twenty year bonds in the last year of the historical period. This seemed fairly typical of at least some of the companies in the annuity business over the past ten years. For the investment of new cash flow during the projection period, various combinations of the five asset types were assumed.

Two other asset structures were tested. One was identical to the first except that ten year bonds were substituted for twenty year bonds as the fifth asset type. The other assumed 100% investment in level sinking fund seven year bonds throughout both the historical and projection periods.

The surrender formula that we used is a function of the difference between the current new money rate and the accrual rate for each block of business; details are in the Discussion Note. We included a retirement function in the calculations, since a lot of single premium business is issued at advanced ages and some are likely to retire.

We tested two levels of surrenders, which we describe as moderate and high. We don't have a good feel for what high surrenders should mean, so we simply doubled the formula result. This is probably consistent with the level of sophistication present in this business -- small annuity contracts issued to unsophisticated investors should not be as interest rate sensitive as larger contracts issued to more sophisticated investors.

The Discussion Note shows reserve adequacy factors for eight combinations of product, surrender and asset assumptions, six involving single premium contracts and two installments, and for each of the ten interest rate scenarios tested. Some of the numbers are sobering, so much so that sometimes we were happy to see surplus requirements of only 10% to 15%.

Product assumptions four (single pay, high surrenders, twenty year bond for fifth asset type) and scenario six (interest rates rising 2% each year from 15% to 25%, then remaining at 25%) produced the largest reserve adequacy factor among those shown, something slightly in excess of two. That means that, on the valuation date, statutory reserves were just half of what was going to be required to mature the obligations over that interest rate scenario. Both installments and single pays can produce numbers like that depending on the choice of investment strategy.

Reserve adequacy factors in excess of two are indeed sobering. But if you look at product assumptions three and six in the Discussion Note (single pay, moderate or high surrenders, 100% investment in level sinking fund seven year bonds), you will note that the reserve adequacy factors in all ten of the interest rate scenarios tested are less than one. This does not necessarily mean that 100% investment in level sinking fund seven year bonds is the best investment strategy; it simply means that it worked for these scenarios and that there are investment strategies that one can feel reasonably comfortable with in doing this type of business.

Another conclusion that can be drawn from the results in the Discussion Note is that, other things being equal, installment contracts are generally safer than single premium contracts. I think that is an obvious conclusion, since installment contracts have future cash flow and may be expected to be a little less sensitive to interest rates and the surrender function. You can have a block of installment business that is dangerous, more dangerous than a block of single premium business, depending on your investment strategy. However, given the same investment strategy, installments are safer than single pays.

MR. ATTWOOD: Thank you Paul and Terry and Dan. As we turn to questions, I would like to mention that we do have other members of the C-3 Risk Task Force in the audience -- I note specifically that Bob Miller, Jim Tilley and Don Cody are here -- and we are going to invite them to join in the discussion, and I may even call upon them as well as the members of the panel to answer some of the questions.

We have heard a good bit today about the considerable amount of research that has been done by the C-3 Risk Task Force, the results of which are either

already in the Record or soon to be in the Record. Specifically and practically, how can this research and these papers help an actuary in testing the adequacy of his company's reserves? Can you start off on that Dan?

MR. McCARTHY: We certainly don't claim to have written a text book, let alone a cook book. We don't even claim to have written down procedures which if followed will produce an answer that somebody could have total confidence in. What we have tried to do is to talk about and publish enough material so that an actuary knowing the circumstances of a particular company for whom he is asked to think about reserve adequacy under C-3 risk will have some means to be able to do so.

Fortunately, the product area in which the need to do this is most far advanced is also the product area in which we are furthest along in our research and understanding of C-3 risk -- that is, with respect to guaranteed interest contracts. New York now requires for a company that wants to make maximum use of the interest rates available in the valuation law that an actuary carry out some tests of the adequacy of the reserves and describe the results in a fashion satisfactory to the Insurance Department. The C-3 risk materials that have already been published for guaranteed interest contracts should prove very useful as background for actuaries having to perform such tests in this year's valuation.

There are, of course, fewer variables to deal with for guaranteed interest contracts than for some of the other product types we have talked about, so it is not surprising to conclude that the work done by the task force on guaranteed interest contracts may be more easily put to practical use than work done on other products.

As Terry has pointed out, and as some of the work done by Jim Geyer and his colleagues has indicated, the potential swings and risks for life insurance appear to be not nearly as substantial as for guaranteed interest contracts. That doesn't mean zero risk, but at least we now have some things before us that people can look at and begin to analyze their own company situations.

While we are now at a point where none of us would have real confidence in writing down standards of practice applicable to C-3 risk over all product types, we can at least begin to think about the needs of particular companies and their C-3 risk characteristics.

MR. ATTWOOD: Dan mentioned the special New York requirement for tests of reserves for guaranteed interest contracts. I would like to ask Carl Ohman, as a New York company actuary, to tell us how the work of the C-3 Risk Task Force responds to that particular requirement.

MR. CARL R. OHMAN: As Dan indicated, the New York Insurance Department introduced a regulation last year in connection with group pension guaranteed interest contracts stating that if a company wants to use the most favorable valuation interest rates permitted, it must submit a certification from an actuary that certain tests had been made of the adequacy of the reserves together with a memorandum describing the procedures and assumptions used in the tests and the results of the tests. This requirement was incorporated this year in the amendments to New York's Standard Valuation Law and expanded to apply to most forms of annuities as well as to guaranteed interest contracts.

The question now for the New York Insurance Department, and for all of those of us who will need to comply with this requirement, is: -- what do we do? What kinds of tests should be done, what assumptions are appropriate, how should results be presented, what should be included in the supporting memorandum?

To help both companies and regulators in addressing these questions, the American Council of Life Insurance set up a task force last summer headed by Mike Sproule of Metropolitan Life. That task force first interviewed a number of ACLI's member companies, those who complied with the special New York requirement in last year's valuation plus a number who didn't, and collected some useful input regarding company attitudes toward this requirement. The task force then proceeded to draft a set of guidelines, or perhaps helpful hints, for use by actuaries in performing the tests and preparing the certification and accompanying memorandum. Work on these guidelines should be completed within the next week or so, at which time they will be made available to interested parties, both companies and regulators.

The proposed guidelines, or helpful hints, are not intended as a statement of what the actuary must do to comply with the requirement; there are a number of approaches that an actuary might use in testing the adequacy of the reserves for guaranteed interest contracts, and I would think it premature to attempt at this time to point to one approach as being superior to all others. What the guidelines do attempt to do is to provide a checklist of the kinds of factors and assumptions to be considered in the tests and which should be discussed in the accompanying memorandum and to suggest at least one approach to performing the tests.

The particular approach described in the proposed guidelines involves projections of investment cash flow and insurance cash flow under various future interest rate paths, basically the kind of techniques developed by Jim Tilley last year and published in the Record for the Atlanta meeting.

I think that this is a good illustration of how the work of the C-3 Risk Task Force can be put to practical use, at least with respect to guaranteed interest contracts and annuities.

MR. ATTWOOD: Switching to another line of business, what about individual life insurance? Do we feel that we really understand the nature of C-3 risk for this business and are we able to practically cope with it? Bob Miller, your company, Aetna, has been in the forefront of this. Do you want to comment?

MR. ROBERT A. MILLER, III: We are not satisfied that we understand the risk as well as we should, in spite of all the work that we have done on it. One of the things that comes clear in the most recent work by Mike Mateja, Jim Geyer and Diane Arndt is that dividend policy in a stock company is just as important as it is for a mutual company. Here I am talking about dividends to shareholders. The questions of earnings capacity of the business and the ultimate economic strength of the company are matters that we still need to study quite extensively.

So we think that there is quite a bit of work yet to be done in this particular area.

MR. OWENS: I can add very little to what Bob Miller has just said. The number of variables that could be changed in these studies is significant, including variations in dividend design and even the level of profit built into the block of business being studied. They all affect the ultimate outcome and there are no general rules. We are not certain what the risk is yet, although we think we understand the techniques that should be used.

MR. McCARTHY: It seems to me, based on some of the tests that have been done, that we have made one assumption which is convenient for evaluating these things in the long term but which could be troublesome in the short term. We assume that in times of negative cash flow, money can be borrowed at certain rates in order to get us over those periods of time. The biggest single problem may be not so much the changing interest rate itself, but the possibility that a need for borrowing happens during a credit crunch, and we saw some of this a couple of years ago, when money is unavailable when you need it most. That is one of the reasons that we have sometimes done alternative tests, and Terry did describe one based on market value cash out that produces more dramatic results. It is nice to think that you will be able to find a way around the short term cash flow problem, but I think it is a mistake to assume that too blithely under economic or political conditions that we can't predict.

MR. JOHN O. MONTGOMERY: I am John Montgomery from the California Department of Insurance and can give some historical perspective leading into the topic of today's discussion.

In 1976, the predecessor to the present NAIC Technical Actuarial Staff formed an advisory committee chaired by Edward Lew that developed a number of questions for the Society of Actuaries having to do with the valuation of insurance company assets and liabilities and related matters. From those questions evolved the formation of the Trowbridge Committee and, eventually, the C-3 Risk Task Force. All the work that has come through the Trowbridge Committee and C-3 Risk Task Force on C-3 risk and the other risks to be examined have been distributed to the NAIC through the Technical Actuarial Staff and its predecessor.

Now the ultimate objective for all of this, from the questions originally posed to the Society of Actuaries, was to determine what minimum surplus a company should have, and that remains the basic question that we are seeking an answer to. I am not sure that we can do it, but I think that eventually out of this will develop some sort of Model Minimum Surplus Law. We don't know what form such a law would take as we don't know what is going to evolve from the efforts of the Trowbridge Committee and C-3 Risk Task Force. But I do think that minimum surplus is the ultimate goal, at least as far as regulatory activity is concerned.

MR. ATTWOOD: What about some of the other lines of business? We haven't heard anything today about the adequacy of group insurance reserves or property casualty insurance reserves. Does anybody have any thoughts or ideas on these?

MR. MILLER: Well, Jim, you have touched a couple of subjects that are near and dear to the hearts of the Aetna. We are a fairly substantial group insurance writer, and we also have a large property casualty business. It is our observation that the principles enunciated by the Trowbridge Committee have perfectly general application, and that just because you are into a term

insurance business, such as group life and health insurance or property casualty insurance, doesn't mean that you do not have C-3 risk.

We have in common with a great many other group writers the phenomenon that our business is gradually changing from a completely insured risk business into an administrative services business, where reserves are not held in cash but rather are secured by the policyholder. When that kind of transformation takes place, the insurance company loses the cash backing the reserves, and the timing is always to the company's disadvantage.

Our reserves in the area of property casualty business amount to something like $4 billion. The so-called liability reserves, the Schedule P reserves, take years to run off. Automobile liability reserves, for example, are completely run off in ten years; but we are still paying claims under our professional liability policies and product liability policies that were incurred more than twenty years ago. It is the opinion of our actuarial staff that our reserve tails may be as long as forty years. Now any kind of business like that does involve a considerable investment risk, and fluctuations in interest rates over time will give us a lot of trouble.

In addition, we have the fact that there is a lot of what we call cash flow underwriting today. Cash flow underwriting can be good or bad, depending upon whether it realistically or too optimistically recognizes the interest rates in the marketplace. One thing cash flow underwriting does do is drive premium rates down, so that at the very time when premium cash flow is most needed it is drying up. Consequently, we see some very considerable problems, not just in the Aetna, but in the industry as a whole, with this particular risk.

Then you get to the question of matching assets and liabilities, and you ought to know that it is sometimes advantageous to take some mismatch so as to enhance your income. When you take mismatch, you take risk, and when you have risk you need surplus to finance it. So you really cannot just blithely go off and accept mismatch without looking at what the cost is going to be.

These are the kinds of things that are going through our heads relative to those particular lines of business. We do think that we understand the regulatory interest that John Montgomery has expressed relative to surplus adequacy. We know that the NAIC's primary concern is solvency and we quite sympathize with it. But we do feel that this is a very complicated subject, and that when you look at the diverse natures of the companies in the insurance business it will be a large order to try to write a law which defines surplus adequacy. We have had some experience in a few mid-western states where they do have such laws, and I think they have created some problems for the various parts of the insurance industry, not because they had inadequate surplus, but because of the ways in which the laws were written. This is a subject that needs to be very carefully thought out.

MR. MONTGOMERY: Actually, the ultimate objective might not take the form of a minimum surplus law but rather that of surveillance or financial ratio tests. We are not sure exactly which route to go, and it might be better to consider a greatly expanded surveillance test, compared to our current series of financial ratios, rather than attempt to write a minimum surplus law. But I do think there are two courses we can take -- the law or the early warning system.

MR. THOMAS J. KELLY: I am Tom Kelly from the New York Insurance Department. First, I want to congratulate the C-3 Risk Task Force on the work they have been doing and are continuing to do. I hope they don't self destruct too soon because we need a lot of help in this area. As Dan McCarthy mentioned, one part of the process is education, and we in the New York Department are definitely still trying to become educated in these matters of C-3 and other kinds of risk.

Dan and Carl have both talked about what New York has been trying to accomplish with its special certification requirement for guaranteed interest contract reserves. There is no magic here. This is one more stage in the Department's effort to give recognition to the dynamic needs of the industry to recognize current interest rates as the investment climate has changed over recent years, while at the same time assuring continued solvency of companies.

We have been concentrating on guaranteed investment contracts related to group pensions. Here the guarantees seemed to involve a definite period so that a matching of assets and liabilities seemed to be the answer. As the investment climate has changed, and the market for guaranteed interest contracts has changed, companies have modified their products so that a strict matching of assets and liabilities may no longer be the simple answer. One such modification is what I would call a contingent type of guarantee which guarantees interest for one year but with a potential for continuing the guarantee for, say, five years and with certain rights of recapture if the guarantee is not continued for the full five years. The risk characteristics of this product are more complicated than for more traditional forms, and we need to know more to understand the proper reserving for such business.

I am particularly concerned with the application of reserve principles that have been developed for the group area to some of the individual products that are being developed, and I hope that Paul Kolkman's work will shed more light in this area.

Again, I think that a tremendous job is being done here, by this task force and others working on these problems.

MR. ATTWOOD: We might note here that the so-called Trowbridge Committee, the Society's Committee on Valuation and Related Problems which is the parent committee for the C-3 Risk Task Force, now has a new head, Don Cody. Don is here today, and perhaps he could tell us what the loose ends are and how we plan to go forward.

MR. DONALD D. CODY: You heard only part of the problem today. The Committee on Valuation and Related Problems has been reconstituted to oversee or act as honcho, that is to see that the whole job gets done. Let me explain very briefly what we have in mind.

We plan to act as a steering committee via additional task forces to extend the work of the Trowbridge Committee and the C-3 Risk Task Force to provide theoretical background for the education of the Society membership, for guidance to the Academy's Committee on Life Insurance Financial Reporting Principles in its efforts to develop standards of practice in this area, and the NAIC Technical Advisory Committee on Dynamic Interest and Related Matters in its advice to the NAIC Technical Actuarial Staff.

Among the areas of interest are these. We have to combine the product level findings of the C-3 Risk Task Force. We need to have a more detailed understanding of the C-1 and C-2 risks, and there are projects underway in those areas already. We have to be able to combine the C-3 risk with the C-1 and C-2 risks. For instance, we might find for certain products that the C-3 risk does not appear too large, except for the catastrophe problem of having to sell your assets at a bad time, and that the C-1 risk may prove to be more important in dollar terms. We cannot lose track of the C-1 or default risk, and of course we have the ever present risk from other sources, like mortality, morbidity, expense, stupidity, various things. We may also have to extend the IYM theory as it impacts on measures of risk to include segmentation of general accounts.

The committee will probably have on its long range agenda the problem posed by the danger of regulation running reserves up to dangerously high levels or of legislating too much in the contingency surplus area. There ought to be an optimum level of reserves for normal contingencies with an appropriate contingency surplus to cover these various risks. If you are too conservative in establishing reserves or contingency surplus, you can make your company die by not having any money left to do the things that enable the company to grow -- this is what I call the vitality surplus.

When you get into vitality surplus, you begin to get into the long range financial plan of the company. Where all this stops, I don't know, except to say that a committee that is concerned with the philosophy of reserves and related problems, and certainly surplus, probably has to consider what happens to the balance of the surplus after these things are set up.

We also have the problem in the Academy of redefining the scope of the valuation actuary's opinion to include the effects and extent of assets and liability matching, and the related need for actuarial education precedent to it. I think that the protection of the industry is really in the professional capacity and integrity and ethics of the valuation actuaries and the actuarial profession generally, and in the end I think the regulators are going to have to depend on this professional integrity, and the Academy is going to have to set up standards for establishing it and providing discipline for it, because otherwise the business can become choked by too rigid over-reserving.

I know that the C-3 Risk Task Force is setting a deadline on itself to self destruct; however, I expect that there will be some continuance with the same faces on other committees and task forces. Nevertheless, we are going to need a great deal of help from other knowledgeable people and their companies to do our work properly.

MR. ARNOLD A. DICKE: From what you have said, it seems to me that a very important factor in all of this was the investment policy, and that obviously affected the results greatly. Have you given any consideration to dynamic investment policies that use some sort of decision rule to minimize the effects of mismatching?

MR. ATTWOOD: As a chief investment officer for the last three years, I can attest to you that it is a dynamic environment and that dynamic practices and policies have to be in existence.

One thing that we are learning, which should be very satisfying to those of you who are on the other side of the balance sheet, worrying about reserves, is that on the asset side there is great opportunity to make changes if there is some mismatching that exists.

The investments of most insurance companies are dynamic investments, whether you believe it or not, in the sense that most companies that borrow funds from at least my company are continuing investment customers of the company. If they are shopping centers, office buildings, hotels or growing companies, they have continuing financial needs. Many are undergoing great financial change, both structural and otherwise. Because of the foresight of some of my predecessors, we have built all kinds of covenants and constraints into the investment documents which, in effect, require the borrowers to come back to us when they wish to make changes. When they do come back to us, we now tell them that conditions have changed and that we want to rewrite the document, changing the terms of the document -- replacing what was previously a 30-35 year document by a 10-12 year document, or continuing the original duration but with provision for contingent interest. Or, if a shopping center with a 35 year mortgage wishes to add to the mortgage to permit growth, we will agree to permit the addition provided we can convert the 35 year mortgage to something much shorter, or perhaps take an equity position rather than a debt position. In the case of one borrower that was on a merger trail and needed our permission, we set as a condition that the borrower pay off an 8½% long term direct placement at par.

We are now alerting our investment staff to the facts of the so-called disintermediation, or intermediation, taking place on the liability side, so that we can take maximum advantage of corresponding opportunities on the asset side. We have learned that what heretofore were considered to be the rules of the game in operating on Wall Street and operating in the securities markets, where you usually agreed to anything the borrower asked you to do, no longer prevail because we are operating under decidedly different financial and interest scenarios.

What I am trying to say is that there are opportunities to restructure your assets as well as opportunities to restructure your liabilities. In working together, the investment and actuarial sides of the house, you can take advantage of these opportunities. Fortunately, in most cases, the scenarios we are talking about and the impacts are relatively long term and give you enough time to restructure both the assets and liabilities.

MR. DICKE: I would like to ask those who have done these C-3 risk calculations whether you included in your models the idea that a company could adopt a dynamic investment policy which would change from year to year relating to the environment. An example of how this might be useful relates to recent suggestions of regulators in California and other states with regard to certain indexed products that there should be an investment policy basically matched up with the liability cash flow. Has that been done in any of your medeling, and could that kind of thing reduce the level of the C-3 risk that you find?

MR. JAMES A. TILLEY: That is a very good point. The kinds of things Arnold Dicke is talking about do in fact occur and give one greater cause for hope.

The various tests of the C-3 Risk Task Force, particularly those relating to guaranteed interest contracts and individual deferred annuities, have shown

that it makes no sense at all to ignore investment policy. In our early modeling, we do assume fairly static investment policies. We just state the investment policies at the beginning and we stick with them all the way through no matter what happens along the path, and this does not seem very realistic. It is realistic for a company that chooses not to look at its investments; as such, the results are very useful. They point out very forcefully that you can't operate the business that way.

What these runs have also shown is that the current minimum reserve standards are adequate in many circumstances even with a static investment policy. Many of the runs, even some of Paul's, showed reserve adequacy factors less than one. That means that on the valuation date the reserves being held, equal to the minimum standard, were in fact adequate to mature the block of business under the range of scenarios being tested. There is great comfort in that as a demonstration of the adequacy of present minimum reserve standards, enough to provide both the valuation actuary and the regulator with some peace of mind.

These results do not give a pricing actuary much peace of mind, because he wants to make money and he wants to make sure that the business is being managed throughout its lifetime to squeeze out as much profit as possible. That is the crux of what you asked about.

Our C-3 Risk Task Force has not done modeling based on dynamic investment policies. I personally have done that kind of modeling for the group pension business because it is a very competitive business and you have to be able to assess right up front when you price a contract whatever beneficial actions you know you will be able to take, and expect will be taken, over the lifetime of the contract. It is very important to do that from a pricing actuary's viewpoint and it does show exactly what you pointed out.

I would expect that the C-3 Risk Task Force, and its successors, will not get heavily into that kind of modeling as that is not really its purpose. The purpose of the task force is to show what risks are there, and how important the investment policy is, and, what I believe to be the next big task, to pull all the pieces together so we can examine the over-all needs of some sample companies.

MR. DOUGLAS S. VAN DAM: If you don't provide for the possibility of changing investment policy to move with the environment in your modeling, and, for example, assume continued investment in twenty year bonds, isn't there a danger that you may be able to find such investments at the point where you have assumed they would be made.

MR. McCARTHY: It turns out, at least in the calculations that Paul ran, that not being able to acquire the twenty year bonds may well only improve the situation.

MR. FRANK E. COLLECCHIA: In your modeling, particularly Paul's, did you use any assumption or scenario with interest rate futures? If not, why not?

MR, KOLKMAN: I did not because it was too messy.

MR. ATTWOOD: Has anybody had any experience using interest rate futures in any modeling? I think this is certainly an area of important development, and, from an investment standpoint, it is going to take on increasing

importance if we continue to have the volatile kinds of investment markets that we have had and the need to hedge some of the investments that we make.

Reference was made earlier to segmentation and the possible need to segment a company's assets to deal with the problem of matching assets and liabilities. I would like to ask someone on the task force whether segmentation is really needed to perform the kinds of tests that were made of the adequacy of reserves under C-3 risk.

MR. KOLKMAN: I don't think that segmentation is necessary. For certain companies, especially large companies with large established blocks of business with distinct liability characteristics, it may seem natural to segment; for others, no.

The approach of the C-3 Risk Task Force in examining the risk characteristics of separate product lines does require an identification of the assets supporting a particular line of business, and segmentation is certainly one way to do this. There are, however, other approaches short of segmentation that achieve the same end.

The real question, of course, is whether the company's total assets are appropriate for the company's total liabilities, and on a company wide basis there is no need to consider segmentation. Indeed, if you do segment and use the segmented assets as the basis for testing the adequacy of your reserves, you may find that some lines of business fail the test, even though the company as a whole passed.

MR. MICHAEL WINTERFIELD: How can our investment departments help in the area of developing indexed or other types of variable rate investments that would help in the management of C-3 risk?

MR. McCARTHY: We have dealt with one company which uses extensively for these types of markets commercial mortgages with rates that are repegged every year, or perhaps every three years. There are other instruments like that around as well. So, while they are not being used terribly widely today in the public investing markets, I suspect that it is only a short step to that since they already exist in private transactions.

MR. ATTWOOD: Variable rate instruments in the mortgage area are, of course, now fairly well known. I am told that they are not popular with prospective borrowers, but they do seem to be offered quite widely. The question is, as interest rates go down and more people borrow for housing, will the industry stay on the variable rate basis, or will it go back to fixed term or baloon or some other more traditional type of mortgage investment.

The Equitable has experimented with, and been fairly successful in a number of variable rate directed placement type investments, and there is even one variable rate public bond issue that came out a few years ago. Again, Wall Street is somewhat slow to react to certain of these needs and changes, but I think the opportunity exists if the insurance company or other investor wants to package something and makes his views known as to what is needed.

This is one of the most important messages to keep in mind here, -- that, in the management of insurance companies today, the investment manager and the actuary have to work very closely together. In my company, we switch back and forth. We have actuaries in investment, and investment people in some

of the more insurance areas of the company. The purpose is for me, for example, to pay the price of having made all those interest rate guarantees ten years ago I now have to find a way to match assets to those liabilities. And this works both ways. Bringing investment and insurance people closer together is a very important part of all of this and I think you are going to see more actuaries in investment in the future and more investment people in the insurance ends of the business. As we move forward we have all got to understand the other side of the balance sheet, whether we are on the asset or the liability side, because in the end the survival and success of our companies will depend on how assets and liabilities are managed in relationship to each other.

Discussion Note

C-3 RISK FOR NON-PAR INDIVIDUAL LIFE INSURANCE

Results of Additional Tests

Prepared by James A. Geyer and Diane L. Arndt

I. Introduction

This paper presents the results of further testing of C-3 risk for Non-Par Individual Whole Life Insurance.

In the first paper on the C-3 risk, which was presented at the Houston meeting, we concluded that there was apparently no material statutory C-3 risk in an increasing interest scenario. In a decreasing interest scenario, there was no threat to statutory solvency unless interest rates dropped below the valuation interest rate. However, in both scenarios, we did note the potential for serious erosion of "economic strength" which was manifest in reduced dividend capacity.

The lack of statutory risk in increasing interest scenarios was quite a surprise. Several explanations were offered:

1. Traditional cash flow timing assumptions used in the analysis led to an overstatement of net investment income by as much as 20% in the high interest scenarios.

2. Policyholder surrenders produced large statutory gains because the assumed cash values were significantly lower than the corresponding reserves released. In fact, in most cases, the market value of assets was sufficient to cover the cash values.

3. In analyzing the C-3 risk, we projected our in-force book of business forward assuming no new issues. All statutory gains were assumed to be paid as dividends to shareholders; statutory losses reduced surplus. Any costs associated with the C-3 risk were thus absorbed by current statutory gains and evident only in reduced shareholder dividends; statutory solvency risk existed only where the aggregate C-3 costs were too great to be absorbed by statutory gains. Had we instead required a certain minimum dividend level, or had we issued new business during the projection period with its associated surplus strain, we believe there would have been material statutory surplus risk.

To address these issues, we made the following changes:

1. We incorporated continuous cash flows into the C-3 model.

2. Cash values and reserves were changed to more realistic scales; in particular, cash values now grade into reserves after 20 years.

At this point, we have not established a conceptual basis for minimum dividends; furthermore, it was not practical to add to the model the capability to issue new business. Consequently, the comments in (3) above still apply.

II. Summary and Effect of Changes

A. Continuous Cash Flows

In our original tests, policy years and calendar years were assumed to coincide. Premiums were paid at the beginning of the year, death benefits were paid halfway through the year, and surrenders and policy loans occurred at the end of the year. The analysis of net investment income in the increasing interest scenarios led to the conclusion that NII was overstated by as much as 20-25% as a result of using these cash flow timing assumptions.

We therefore adopted the methodology described in P. Huffman's article, "Asset Share Mathematics" (TSA XXX p. 277), which permits us to convert policy year cash flows to calendar year cash flows, and to reflect continuous cash flows. We now assume policies are issued continuously, premiums and death benefits are payable continuously, and surrenders and policy loans occur continuously.

The following chart illustrates how the new cash flow assumptions affect investment income in a particular year. Both runs use the same reserves, cash values, and premium scales, though there are slight differences in actual amounts because of the change in approach.

Sources of Net Investment Income
Traditional vs. Continuous Cash Flow Assumptions
Year 25
Increasing to 25%*

	Traditional	Continuous
Interest on Assets On Hand at the Beginning of the Year (Including Policy Loans)	$186,511	$190,920
Interest on Insurance Cash Flows During the Year		
Premiums	52,268	27,277
Death Benefits	-11,856	-11,094
Surrender Benefits	0	-14,657
Expenses	-7,496	-4,309
FIT	-5,345	-3,236
Increase in Policy Loans	0	-11,638
Total	27,571	-17,657
Total Investment Income	$214,082	$173,268

*Scenario 3 in the original paper; interest rates increase 2% each year from 15% to 25%, then remain level at 25%.

This result is representative of the high interest scenarios, and confirms that traditional cash flow assumptions can produce a material overstatement in aggregate investment income.

B. New Reserve and Cash Value Scales

Our original cash values and reserves were the statutory minimums assuming the 1980 Amendments to the Standard Valuation and Nonforfeiture Laws were in effect in past years. Consequently, the cash value interest rate was 125% of the reserve interest rate. This fact, combined with our use of CRVM reserves and minimum cash values, led to large margins between cash values and reserves. To increase the reasonableness of our reserves and cash values, we adopted the AEtna scales for Ordinary Life for the years 1962-1981. In the first 12 issue years, NLP reserves are used; in subsequent issue years, reserves grade from CRVM to NLP after 20 years. The cash values for all issue years grade to the corresponding NLP reserves after 20 years. The following table compares the original and revised valuation and nonforfeiture interest rates.

Original			Revised		
Issue Years	Val. Rate	CV Rate	Issue Years	Val. Rate	CV Rate
1962-68	3.5%	4.5%	1962-67	3%	3%
1969-71	4.0	5.0	1968-75	3½/3*	3½/3*
1972-76	4.5	5.75	1976-81	4	4
1977-81	5.0	6.25			

*3½% for first 20 years, then 3%.

Note that the application of the 1980 Amendments' dynamic interest provisions in our original analysis led to relatively higher rates in past years than were actually used, particularly for cash values.

Ratios of cash values to reserves are shown below for the level 15% interest scenario.

Ratio of Aggregate Cash Values to Aggregate Reserves

	Including Policy Loans		Excluding Policy Loans	
Year	Original	Revised	Original	Revised
20	.73	.89	.64	.84
25	.78	.95	.70	.92
30	.82	.98	.75	.97
35	.85	1.00	.79	1.00
40	.87	1.00	.82	1.00
45	.88	1.00	.84	1.00
50	.90	1.00	.86	1.00

It is clear that the gain upon lapse due to the cash value/reserve margin will be considerably reduced with these revisions.

Another effect of these revisions is that, in the high interest scenarios, the asset market values now are lower than the corresponding cash values. Unlike the original tests then, there should now be true economic loss upon lapse in these scenarios. Exhibit 1 compares asset market values at various years to the aggregate cash values available.

III. Cash Flows

Exhibit 2 presents a series of cash flow graphs corresponding to those in the original paper. The only significant change from the original graphs is in the increasing interest rate scenario, where insurance cash flows now exceed asset cash flows in some years. This is a direct result of our new cash flow timing assumptions and the new reserves and cash values described above.

IV. Statutory Results

Surprisingly, our tests still indicate minimal statutory risk. We found a satisfactory explanation for these results by examining the sources of statutory earnings.

Gain from operations can be viewed as income less expenditures less the change in reserves. Gains or losses arise when actual income or expenditures differ from those implicit in the reserve structure.

The major sources of gain and loss are:

- Gross premiums less expenses vs. reserve net premiums.
- Net investment income vs. reserve required interest.
- Death benefits vs. reserve mortality basis.

These are commonly referred to as the Loading, Interest margin,and Mortality margin, respectively.

These are certainly not the only sources of gain/loss, however. Others are surrenders, policy loans, and FIT.

- Surrenders generally have little effect on gain or loss in the year they occur, as long as the reserve released is approximately equal to the cash value paid out. This is true with our revised scales.

- Policy loans have no effect on statutory gain/loss in the year they occur, except to the extent that investment income is affected.

- Federal Income Tax does affect the magnitude of the gain/loss, certainly. But because of the mechanics of FIT with respect to Taxable Investment Income and Gain From Operations, FIT generally only affects the size of the three basic margins. FIT will generally not by itself cause positive margins to go negative, or vice versa.

For this discussion then, we can focus on the three basic margins.

The relationship among these three sources of gain/loss changes over time. In the first year the loading element is negative, due to the large initial expenses. This in turn leads to negative GFO and surplus strain. In later years, the loading element becomes small as expenses level out, mortality margins increase as mortality rates rise (but eventually fall due to the declining amount at risk), and the interest element becomes larger as the assets increase. The resulting gains from operations in these later years represent a payback of the initial investment of surplus and a profit on that investment.

In terms of our particular C-3 risk tests, the margins interact in the following manner:

1. The margin between (G-E) and P is close to 0 for this mature block of policies. It may be negative at times, but the amounts are insignificant compared to the mortality and interest margins.

2. Substantial margins exist between actual mortality and valuation mortality, since reserves are based on 1958 CSO and assumed actual mortality is 100% of the 65-70 Basic Select and Ultimate table for men.

3. The interest margins provide the largest contribution to GFO in these tests. At the beginning of the projection period, the average portfolio rate is 9%, ignoring policy loans. The average valuation interest rate however is only 3.5%. It is clear that there is substantial margin at the outset.

Consider the following table of net investment income vs. interest required on reserves for three sample interest scenarios.

	Level 15%			Increasing to 25%			Decreasing to 5%		
Year	NII	Req. Int.	Margin*	NII	Req. Int.	Margin*	NII	Req. Int.	Margin*
20	$152	$83	$ 69(83%)	$152	$83	$ 69(83%)	$152	$83	$ 69(83%)
25	223	96	127(132)	189	89	100(112)	199	103	96(93)
30	232	86	146(170)	92	45	47(104)	172	122	50(41)
35	204	68	136(200)	43	18	25(139)	185	129	56(43)
40	159	50	109(218)	18	7	11(157)	184	129	55(43)

*Numbers in parentheses are % of Required Interest.

Comparing the increasing interest rate scenario with the level base case, we see that the interest margin is lower in the increasing scenario, but still substantial. The interest margin is also lower in the decreasing scenario than in the base case, but as long as new money rates remain above 3.5%, the average valuation rate, this source of margin remains positive.

In the increasing interest rate scenario, there is negative cash flow as a result of high lapses and policy loans. In addition, the market value of assets is now lower than the corresponding cash values. It is necessary to either borrow money at high rates or liquidate assets at a capital loss to cover the cash outflows. However, there is no threat to statutory solvency in our tests because the current margins are large enough to absorb the impact of borrowing costs or capital losses.

This is a key point. Negative cash flows do not by themselves imply statutory risk. If it is necessary to liquidate assets at a loss, or borrow at interest rates above the portfolio rate, statutory earnings will certainly be depressed. As long as the various margins are large enough to absorb such costs, there is no statutory risk.

The above table assumed negative cash flows were covered through borrowing. The effect on net investment income of liquidating assets is presented in Exhibit 3. When assets are liquidated, net investment income is reduced for that year by the capital loss. In this test, the capital losses did not depress net investment income below the required interest level.

Below are new statutory surplus requirements based on ten different interest rate scenarios.

STATUTORY SURPLUS REQUIREMENTS

	Base	Increasing				Decreasing				
	1	2	3	4	5	6	7	8	9	10
				New Money Rates						
Year										
1982	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
1983	15	18	17	16	17	12	12	12	15	11
1984	15	21	19	17	18	10	10	10	15	7
1985	15	25	21	18	21	8	8	8	15	3
1986	15	25	23	19	23	6	6	6	15	3
1987	15	25	25	20	25	5	5	5	11	3
1988	15	25	25	21	27	5	4	4	7	3
1989	15	25	25	22	29	5	4	3	3	3
1990	15	25	25	23	31	5	4	3	3	3
1991	15	25	25	24	33	5	4	3	3	3
1992	15	25	25	25	35	5	4	3	3	3
1993-2022	15	25	25	25	35	5	4	3	3	3
				Required Statutory Surplus[1]						
New Results										
Lapse & Loan Rate										
Moderate	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Extreme	0	0	0	0	1	0	0	0	0	0
Original Results										
Moderate	0%	0%	0%	0%	0%	0%	9%	40%	37%	43%
Extreme	0	0	0	0	1	0	7	35	29	37

[1] As a % of reserve as of the beginning of the projection period (12/31/81)

These results are identical to the original runs with the exception of scenarios 7 through 10, where interest rates fall to 3 or 4%. As noted earlier, the reserves in the initial tests were based on 4-5% interest; consequently NII was not sufficient to cover required interest in these scenarios. With the new reserves based on lower interest rates, we did not encounter any solvency risk.

In these runs, there were substantial margins between actual interest and interest assumed in pricing. To test whether this was somehow protecting us from C-3 statutory risk, we priced assuming 10% level interest, assumed the actual interest rate in the historical period remained at 10%, and then projected the block of business forward under various interest scenarios.

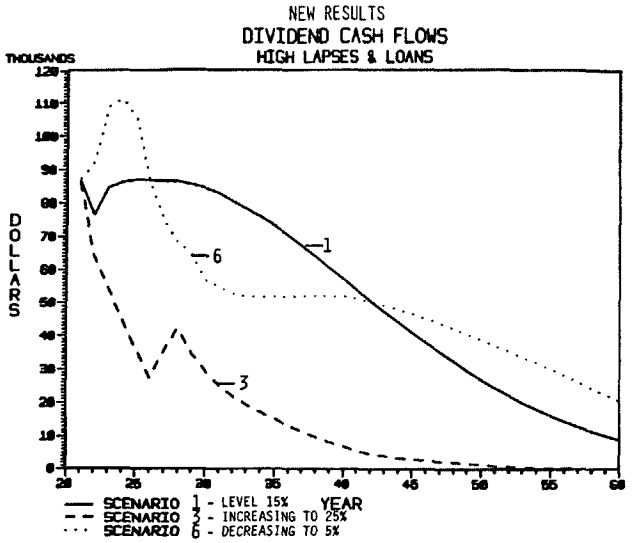
Once again no statutory risk was found, even when interest rates dropped substantially below 10%. The pricing assumption affects the relationship of gross premiums net of expenses to net valuation premiums. In this test, the loss from this source was outweighed by the mortality and interest gains; as long as the interest margin did not go negative, there was no C-3 statutory surplus risk. Exhibit 4 gives further details of these results.

These various additional tests reinforce the original conclusion that there is no threat to statutory surplus from the C-3 risk as long as enough interest income is generated to cover required interest on reserves. In fact, it is possible to have large negative cash flows in some scenarios, and still survive on a statutory basis. The key is the impact of borrowing costs or capital losses on aggregate investment income and the relationship of the resultant net investment income to reserve required interest.

As noted earlier, this result is closely tied to the dividend policy. Furthermore, this statutory strength does not necessarily imply economic strength.

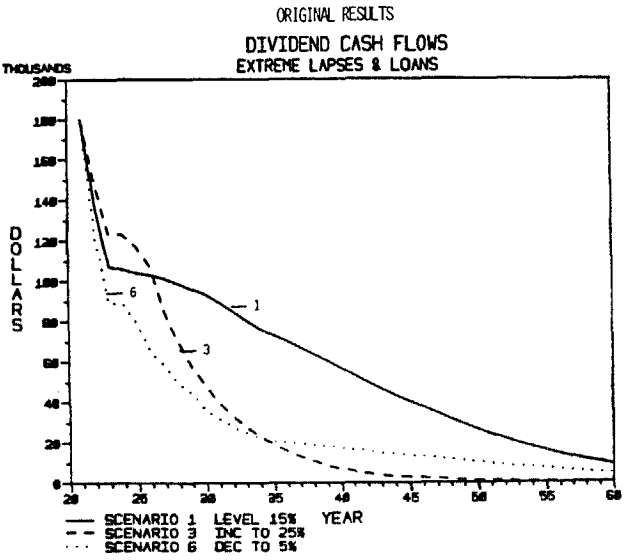
V. Economic Strength

The graph below shows dividend levels under three scenarios for the new runs.



Dividends in the decreasing interest scenario are at a comparable level to those in the level interest scenario. Although declining new money rates depress dividends per unit, the larger in-force (fewer lapses) prevents a substantial decrease in aggregate dividends. In the increasing scenario, however, dividends are sharply reduced, largely as a result of the rapidly shrinking in-force.

Below is the comparable dividend graph from the original runs.



Comparing the two graphs, it is seen that the increasing interest rate scenario hurts much more now than in the original tests: lapses do not lead to large statutory gains as before, and lapses and loans now depress NII to a much greater extent.

In the original report, variations in the dividend levels were viewed as changes in economic strength.

The table below shows present values of dividends for three scenarios which puts dimension on the potential variation in economic strength. Although the magnitudes are heavily dependent on the discount factor used, the relationships are not: in particular the increasing scenario hurts us the most, and the decreasing interest scenario appears best.

Present Value of Dividends-New Results
(000 Omitted)

	Discount Factors	
Scenario No.	15%	New Money Rates
1 - Level 15%	$570,106	$570,106
3 - Increasing to 25%	318,249	280,289
6 - Decreasing to 5%	577,128	931,851

There are other viewpoints to illustrate how the C-3 risk affects economic strength.

When a company issues new business, it experiences surplus strain in the early years. This is especially true where it must establish conservative reserves, as with Individual Life. In return for this initial investment, the company expects a certain level of return. Viewed in this way then, another aspect of the C-3 risk is the risk that the return on the initial investment is lower than expected (it may even become negative!).

To study this, we computed internal rates of return for three interest scenarios using 60 years of statutory GFO's for each. The first 20 correspond to the historical period, and are mostly negative; the next 40 correspond to the projection period. The results:

Interest Scenario	IRR
Level 15%	8.9%*
Increasing to 25%	5.7
Decreasing to 5%	8.8

Clearly the increasing interest scenario reflects a material reduction in profitability.

A similar approach is to accumulate past losses less gains as a measure of the accumulated initial investment in the block of business, which is independent, of course, of future interest scenarios. The present value of future gains, less losses, is then determined for various scenarios, and compared to the accumulated initial investment. Results on this basis are as follows:

Accumulated value of gains/losses in historical period @ 8.9%:**	$838M
Present value of gains in projection period @ 8.9%:**	
Level 15%	838
Increasing to 25%	393
Decreasing to 5%	825

*These results are based on extreme lapses & loans. With moderate lapse and loan assumptions the level 15% IRR would be 10.5%.

**The 8.9% rate was used since this is the expected return based on the level 15% scenario; note that for the level 15% scenario then, the present value of gains equals the accumulated initial investment.

At the end of 20 years, the beginning of the projection period, the statutory liability is $2,116M. As shown above, the value of future dividends for the 15% base case level is $838M. In order to maintain dividends at this level, even in an increasing interest scenario, additional surplus of $445M would be required ($838-393), 21% of reserves. This percentage increases to 32% if we only consider statutory liabilities net of policy loans. This can be viewed as indicative of the additional surplus needed to assure solvency under this particular interest scenario, if dividends were maintained at the base case level.

VI. Conclusions

The additional analysis has provided a clear understanding of the nature of the C-3 risk and how different elements affect it. There continues to be no threat to statutory solvency under the assumed dividend strategy, because of the large margins between NII and required interest. However, the level of shareholder dividends is considerably reduced in the increasing interest rate scenario.

In reality, in a stock company setting, new business is written with the expectation of achieving a certain return on surplus required to support the new business. The profits in later years may be used to pay shareholder dividends, or to cover the strain of additional new business, i.e., reinvested in the business. In practice, there is some combination of these two uses of profits. In any case, it is clear that if it were assumed that the block of business continued to yield a given dividend stream, regardless of actual statutory gain from operations, and money was removed at this level in the various interest scenarios, there would be substantial threat to statutory solvency. The prior section provides some idea for the potential magnitude of this threat.

EXHIBIT 1

Market Values vs. Book Values

In our original analysis of the C-3 risk, we concluded that some of the lack of risk was due to low cash values relative to reserves. In fact, cash values were so low that, even in an increasing scenario, the market value of assets still exceeded the cash values. Even if we had to liquidate assets, we were not in trouble with respect to statutory solvency.

Under our new assumptions, we found the following relationships between market values and book values.

Scenario 3 - Increasing to 25%
Assets, Reserves,and Cash Values
(Net of Policy Loans, End of Year, -000,000 omitted)

Year	New Money Rate	Book Assets	Statutory Reserves	Market Assets	Cash Values
20	13.7%	$1,406	$1,406	$1,166(-17%)	$1,174(-17%)
25	23.0	975	975	633(-35)	872(-11)
30	25.0	401	401	246(-39)	384(-4)
35	25.0	165	165	113(-32)	164(-1)
40	25.0	64	64	47(-27)	64(0)

Percentages in parentheses are the percentage reductions from the corresponding statutory assets or reserves.

Cash values now exceed market value of assets. If everyone lapsed at once, and assets were liquidated to pay cash values, it is clear there would be statutory loss.

EXHIBIT 2

Cash Flow Graphs

Below are new cash flow graphs corresponding to those included in the original C-3 paper. The graphs are essentially unchanged with the exception of Scenario 3.

A. Graphs of Specific Cash Flows

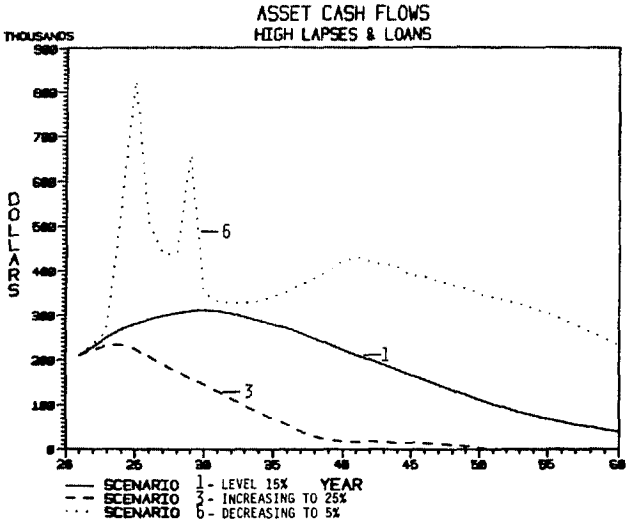
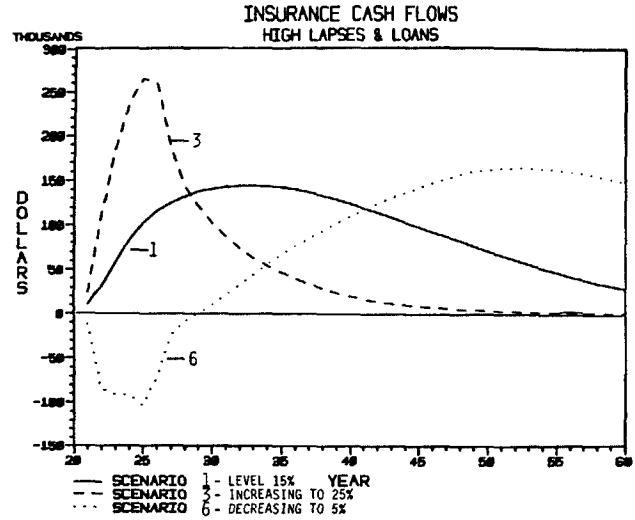


Exhibit 2


INSURANCE CASH FLOWS
HIGH LAPSES & LOANS
THOUSANDS
DOLLARS
3
1
6
SCENARIO 1 - LEVEL 15%
SCENARIO 3 - INCREASING TO 25%
SCENARIO 6 - DECREASING TO 5%
YEAR

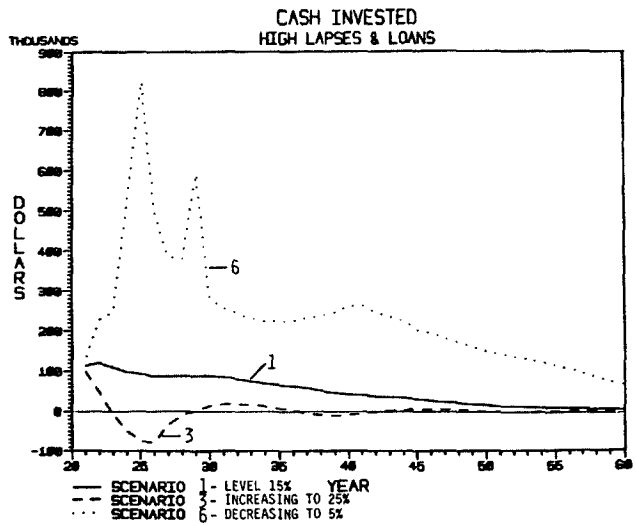
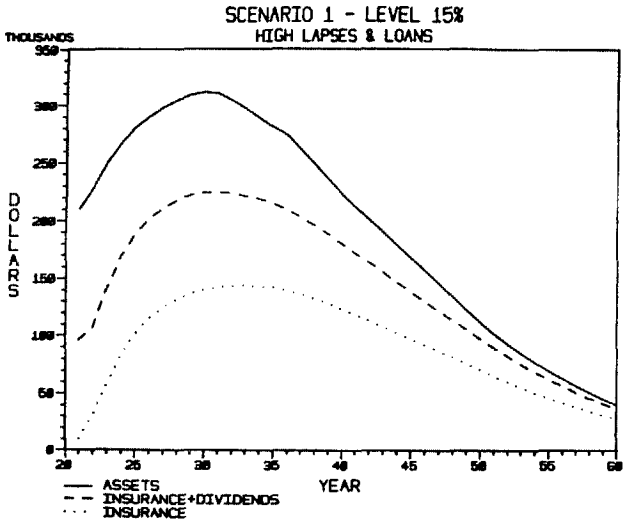

CASH INVESTED
HIGH LAPSES & LOANS
THOUSANDS
DOLLARS
6
1
3
SCENARIO 1 - LEVEL 15%
SCENARIO 3 - INCREASING TO 25%
SCENARIO 6 - DECREASING TO 5%
YEAR

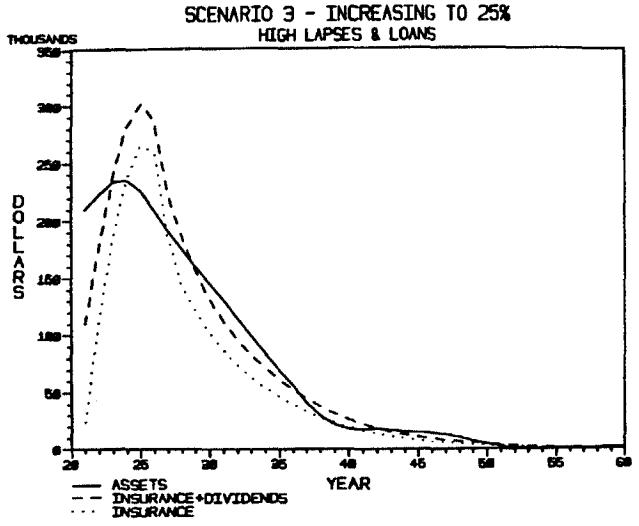
Exhibit 2

B. Graphs of Scenarios



The cash flows in Scenario 3 differ significantly from those in our original runs, as shown below.

Exhibit 2



The changes in cash flow timing assumptions affect the relationship of insurance cash flows to asset cash flows. Because net investment income is no longer overstated,the insurance cash flows now exceed the asset cash flows in some years.

The new cash value and reserve scales result in lower statutory gains upon lapse or surrender, thus lower dividends.

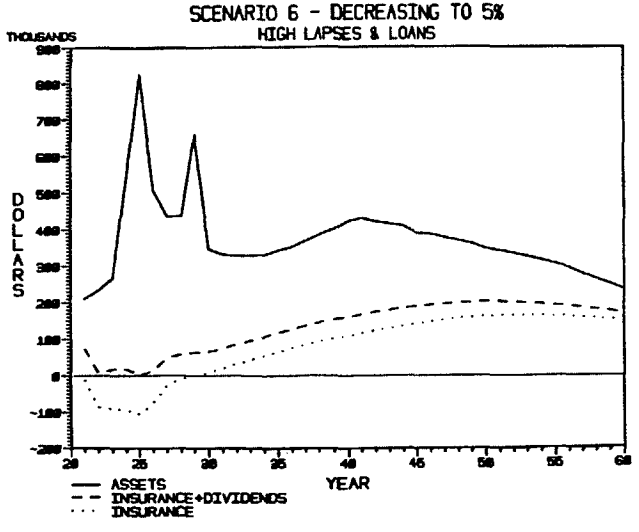


EXHIBIT 3

Asset Liquidation vs. Borrowing

The effect on net investment income of liquidating assets vs. borrowing money is illustrated below for the increasing interest rate scenario, using our new assumptions.

Scenario 3

Increasing to 25%
(net of policy loans)

			Net Investment Income		
Year	New Money Rate	Net Cash Flow*	Borrowed Money Method	Asset Liquidation Method**	Reserve Required Interest
23	19%	$ -6,265	$143,293	$143,821	$61,289
24	21	-47,693	139,815	134,222	56,322
25	23	-75,868	128,772	109,364	50,267
26	25	-77,012	112,144	86,494	41,978
27	25	-30,729	94,371	82,557	34,300
28	25	-10,338	79,629	81,449	28,513
29	25	3,527	66,085	74,932	23,750
30	25	14,122	55,995	72,994	19,820

**From borrowed money test; would be slightly different for test of asset liquidation.
*Reflects capital loss.

Borrowing depresses all later NII's whereas in asset liquidation the effect of the capital loss is felt only in the year of sale. In either case, NII is more than enough to cover required interest.

If lapses or loans increased substantially, and the additional cash outflow was covered by selling assets, it would be possible to depress NII below the required interest level. For example, in year 26, this would occur if policy loans increased from 60% to 70% of available cash values. If we instead borrowed money, we could survive an increase to 75-80%. With asset liquidation, we must cover the capital loss with that year's margins only. With borrowing, we can borrow against future years' margins and thus withstand greater cash outflows in a given year.

EXHIBIT 4

Alternate Pricing Interest Rate

In pricing for this model, the interest rate in the first year was set equal to the new money rate in the year of issue, with interest rates decreasing thereafter. In the C-3 runs, actual new money rates were used during the historical period. These actual new money rates were considerably greater than the corresponding pricing rates. It was possible that this favorable relationship protected us against statutory risk.

To test this theory, level 10% interest was assumed in pricing. The model was then run with 10% interest in the historical period and various increasing and decreasing assumptions during the projection period. Once again, there was little threat to statutory solvency as long as interest rates remained above the valuation interest rates. One example is shown below.

Decreasing to 5.25%*

Year	NII	Required Interest	Gain From Operations	
			Before FIT	After FIT
20	$85,975	$56,912	$ 7,894	$ 7,894
25	91,724	73,997	36,274	25,695
30	90,627	87,802	12,209	8,854
35	97,238	94,435	4,004	2,437
40	98,074	94,425	2,557	1,374

*5.25% is the valuation interest rate.

Discussion Note
C-3 Risk For Participating Whole Life
Prepared by Terrence M. Owens

The C3 risk is associated with the problem of asset-liability matching under varying interest environments and is considered distinct from the mortality or expense risks of pricing (the C2 risk) or with the risk of asset default (the C1 risk). The C3 risk problem may thus be defined as determining whether the assets behind a block of business on a valuation date will be sufficient under future interest rate environments :

1. To fund the obligations of the block of business over the entire period of the guarantees, and
2. To assure statutory solvency with regard to that block over all future valuation periods.

A method developed to answer this question for guaranteed interest contracts was presented by James Tilley at the Atlanta meeting in the fall of 1981 (RSA vol. 8, no. 4, pp 1368-1377). James Geyer extended the methodology to the non-participating whole life contract and presented the results of that study in Houston in March (RSA vol. 8, no. 1, pp 27-40). In addition to illustrating the methodology on a sample non-par block, the non-par presentation showed how an examination of the cash flows developed in the process give insight into the nature of the C3 risk problem. This paper presents the application of the GIC and non-par life methodology to the participating whole life contract.

Briefly, the method used in studying the C3 risk, as presented in Houston, involves projecting a given block of business together with its corresponding assets over future valuation periods allowing only prevailing interest rates and cash flows clearly dependent on those interest rates to vary. The minimum surplus required at the valuation date to maintain statutory solvency over the projection period is a measure of the C3 risk associated with that projection. Generally the surplus requirements are noted under a wide variety of plausible interest rate "scenarios" in order to get a better understanding of this risk.

In order to specify the characteristics of the asset/liability block under study, a block of business is developed using (in the non-par case) 20 years of issues representing the historical period 1962-1981. Cash flows are invested as they arise in instruments typical of the period. The well-defined closed block of business which results together with its asset portfolio as of year end '81, form the block under study.

Ultimately the credibility of these studies lay with our ability to identify for this block the cash flows which have been shown to be dependent on the interest rate environment in the past, and provide reasonable explanations for their expected behavior in the future.

On the asset side the approach is relatively straightforward. The effect of a change in interest rates will of course show on the yield on new investments. If interest levels have dropped, there is as well an increased incidence of calls on investments made at higher rates. These may be predicted with a fair degree of confidence.

On the insurance side cash flows become far less predictable. Attempts to predict the policy loan level or lapse activity in a 25% interest environment, for example, based on extrapolations from the past, involve a high measure of pure speculation. For participating policies the dividend process in a developing "catastrophe" scenario will be subject to market pressures whose influence will depend on the extent to which the interest rate danger is perceived. There is not adequate experience to predict with any confidence the extent to which the dividend levels will be allowed to reflect deteriorating investment experience.

The results of these studies are highly influenced by the assumptions made regarding the behavior of these elements.

ASSUMPTIONS: PARTICIPATING WHOLE LIFE

The block of business under study is made up of a mix of participating whole life policies typical of the period 1962-1981. Three dividend classes were used: 10 years of issue for a 2½% CRVM block with a 5% policy loan provision followed by 5 years of 3½% CRVM with a 6% loan provision and 5 years of 4% CRVM with an 8% policy loan rate. All issues were assumed male and gross premiums were taken from rate books in effect for those periods. Commissions and expenses were assumed at current levels based on an average policy size of $40,000. New issues were set at $1 million in year 1 and were allowed to grow in volume by 5% per year during the historical period.

Cash values were set at a level typical in most mutual companies of the period by grading off a $7½ per $1000 surrender charge over 10 years. This contrasts with the minimum cash values used in the non-participating whole life study in which it had been assumed that the 1980 Amendments to the Standard Valuation and Non-forfeiture Laws were always in effect. As a result, and in contrast to the non-par study, little or no gain from surrender was expected to offset losses arising from lapse. This is one of the reasons it was felt a greater C3 risk would emerge for the participating contract.

A more obvious point of contrast with the non-par study was the inclusion of policyholder dividends as a non-guaranteed policy benefit. This element is of course missing from the non-par case. A clearly stated dividend policy is then central to this issue. For this purpose dividend formulas providing for an automatic pass-through of developing experience as presented by Mr. Donald Cody at the Orlando meeting (RSA vol. 8, no. 2, pp 444-448 and 457-459, also "An Expanded Financial Structure for Ordinary Dividends", TSA XXXIII, preprint of Aug. 7, 1981) were used throughout the historical and projection periods. These dividend formulas rely on IYM procedures and provide for complete pass-through of experience to the policyholder subject only to an 18 year amortization period for excess initial expenses and a profit charge set at 0.5% of reserves in each year following the amortization period. In addition a measure of investment pooling was provided by crediting each dividend class with an investment yield determined as a weighted average of the IYM rate earned on that class and the portfolio average yield. A 50-50 weighting was used for this purpose.

A rather important assumption was that dividends would be pegged in response to market pressure (that is no policyholder would see his dividend decrease from the preceding year) only when interest rates are stable or rising and exceed a base rate of 8%. No provision was made for recovering the amounts pegged by charges to future dividends as in some scenarios (notably the 25% flat interest scenario) there would be no hope of recovering these funds. New England Life experience was used to develop a formula to project policy loan levels as a function both of duration and the spread between the new money rate and the policy loan rate. Lapse rates were in turn determined as a function of duration, new money rate and the level of policy loans outstanding. The sensitivity of these formulas will be apparent in the examples discussed later.

FIT calculations assumed a phase 1 FIT position under the '59 act for the 20 year historical period moving into a phase 2 negative FIT position with 77.5% dividend deductions under TEFRA (STOPGAP) for the forty year projection periods. Although CRVM reserves are used throughout, the Sec. 818(c) adjustment was not elected in these runs to avoid the dividend discontinuity which would otherwise have resulted as the tax position changed with the beginning of the projection period.

All investment assumptions were taken directly from the non-par study. In the historical period new investments had an average life of 12.2 years while in the projection period new investments had an average life of 10.8 years. A five year call protection period was assumed, after which call probabilities were dependent on the spread of interest rates from issue, with 95% probability of call when new money rates exceeded coupon rates by more than 3%.

Mortality was assumed to follow the 1965-1970 Male Select and Ultimate Tables.

This covers the basic assumptions used in this study except to note that the participating block under study was envisioned as part of a larger corporate body; that is, a corporate parent was assumed available to absorb surplus strain in the historical period, take advantage of negative FIT positions and lend money when needed in accordance with the usual IYM procedures. This simplified the calculations considerably, avoiding for example the necessity of dealing with problems like tax loss carry-forwards in the historic period or asset liquidation during periods of negative cash flow.

SAMPLE CALCULATIONS

We began by studying three scenarios which we believed would best illustrate the risks developing across the interest rate spectrum. Scenario 1, a flat 15% interest environment, represents a "more of the same" base against which we could compare two extreme scenarios. The two extreme scenarios both involve a quick rise from the 15% level to the 25% level exacerbating policy loan and lapse experience and providing a thorough shake-out of the in-force. Scenario 2 remains flat at the 25% level to maintain lapse pressure throughout the projection period while scenario 3 falls quickly from the 25% level to 4% to put pressure on reserve requirements. It should be emphasized at this point that while these extremes are useful for illustration purposes (they make better graphs) environments characterized by the more moderate interest rate fluctuations of the past were also studied.

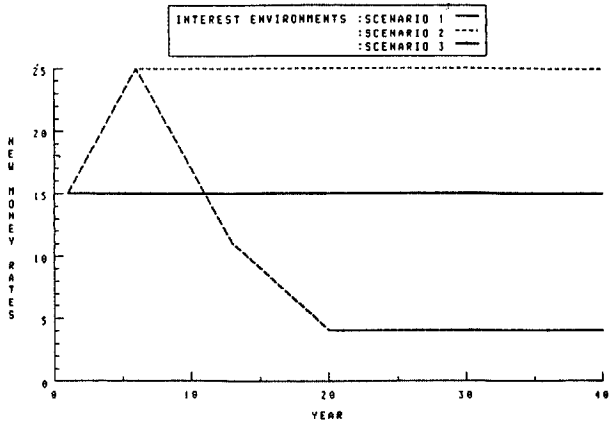


FIG. 1

Figure 2 illustrates the sensitivity of the loan and lapse assumptions to the interest environment. The floor and ceiling to this activity even in the extreme scenarios indicate our belief that on the one hand there will always be a basic "need" component to policy loan usage during periods of low new money rates while at higher new money rates a basic core of policyholders will maintain their policies unloaned either through inertia or because they place a greater value on the insurance element.

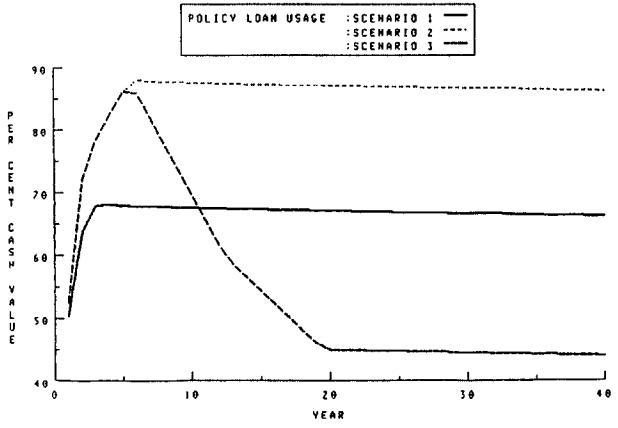


FIG. 2

It can be seen that all projection periods in this study begin during an era of high policy loan activity brought on by the steady rise in interest rates over the historic period from about 4½% to 15%. This policy loan activity beginning each period dominates the insurance cash flow patterns.

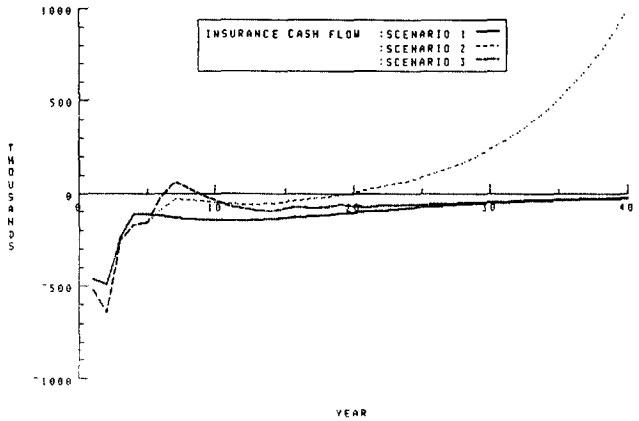


FIG. 3

Insurance cash flows are shown above. They are defined here as:

GROSS PREMIUMS
+POLICY LOAN INCOME
-INCREASES IN POLICY LOANS
-DEATH BENEFITS
-SURRENDER BENEFITS
-EXPENSES
-FIT
-POLICYHOLDER DIVIDENDS

This definition is consistent with that used in the non-par study with the addition of the policyholder dividend element. The signs here are reversed however to emphasize that the insurance side presents primarily a drain on resources throughout the projection period.

As expected, the insurance cash flow patterns which emerge are quite similar to those exhibited in the non-par study, with the higher cash values for the participating product showing up in higher peaks or lower valleys when policy loan activity is prevalent. Essentially cash flow turns positive only as policy loans are repaid as interest rates fall to 4% under scenario 3. The inclusion of FIT as an insurance cash flow has an unexpected result in the later stages of scenario 2 (level 25%). What has happened is that the interest being paid on the funds borrowed from the corporate parent to peg dividends produces a net negative FIT for participating block.

Before we continue, we should take time to consider the dividends being paid under these scenarios. An issue age 35 dividend history for a policy issued in year 5 (2½% CRVM, 5% policy loan rate) is illustrated below.

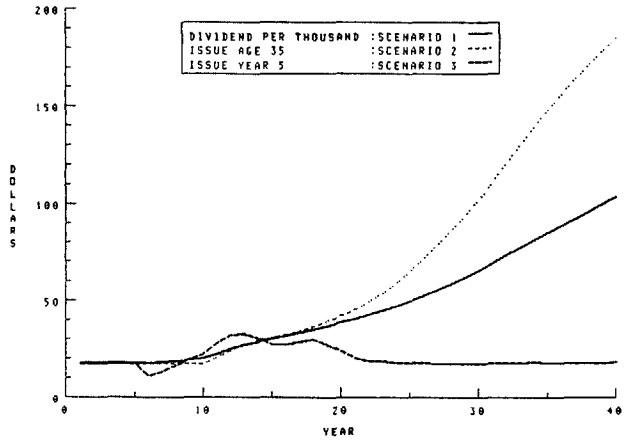


FIG. 4

During the initial interest rate climb to 25% all three scenarios require some pegging. This is evident from the generally flat dividends in the first five projection years (years 20-25). The pegging is removed in scenario 3 (15%-25%-4% flat) as interest rates fall below 8% consistent with our assumption about market pressure, but continues to be necessary for several years under scenario 2 (15%-25% flat). Because the amounts pegged were not charged against future dividends, the dividends paid under this latter scenario were allowed to rise naturally after the dividend block stabilized. The dividend levels under the 4% scenario tend toward a level approximating the 1½% gain from interest on this block (4% earned less 2½% reserve requirement).

The interest payments on the funds borrowed at rates of 25% to peg dividends under scenario 2 eventually drive the asset cash flows into a permanently negative position as can be seen in the following figure.

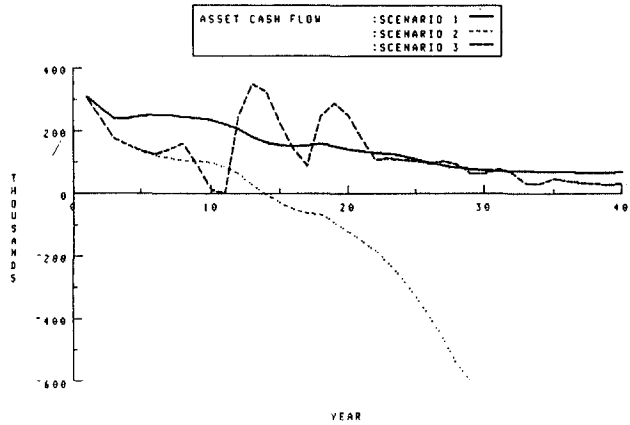


FIG. 5

Asset cash flows include investment income and maturities less payments on borrowed funds. These flows remain positive except where the level of dividend pegging call for significant borrowing. This follows in part because we are dealing with a closed block of business and asset lengths tend to reduce naturally. Thus as the block ages and fewer new investments are made, the average life of the assets in the portfolio drops from a maximum of just under 9 years at the valuation date to 7 years or lower depending on the scenario being run. This inherent source of liquidity placed asset cash flows at a relatively higher level than would be expected for an open block of business.

The base 15% level scenario shows a relatively smooth and positive asset cash flow throughout, while the twin spikes occurring in scenario 3 indicate the operation of two five year call protection periods successively expiring in the prolonged interest rate slide from 25% to 4%.

When the cash flow sources are combined the three scenarios present quite different patterns of net investable cash flow. From an investment standpoint, scenario 3 poses the greatest challenge with policy loan repayments and investment calls providing periodic inflows for investment at successively lower returns.

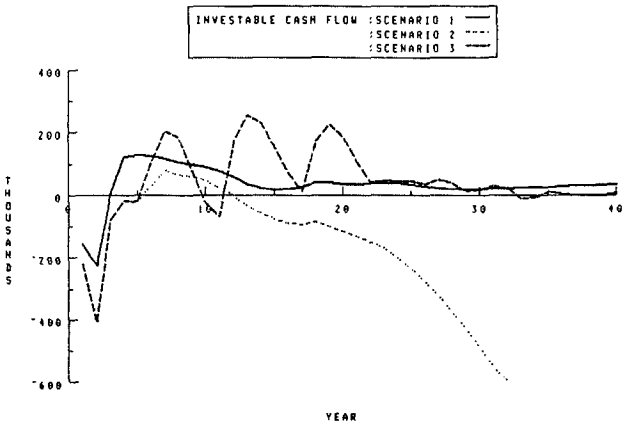


FIG. 6

RESULTS

Our goal was to note the surplus required at the valuation date to insure solvency over varying projection periods. The following graph illustrates the situation for the 25% flat scenario.

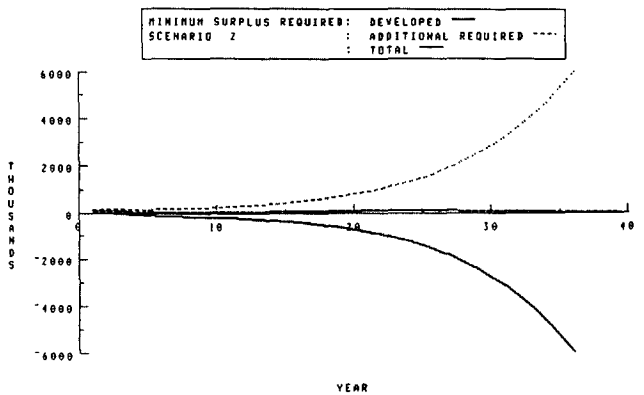


FIG. 7

Note that the flat 25% interest assumption leads to a substantial deficit at the end of the projection period ($10,059 thousand) but also produces substantial growth during that period for any additional surplus available at the valuation date to cover future deficits. That is to say, the surplus required at the valuation date to cover this eventual deficit ($95 thousand) is actually much smaller than might first be supposed.

The concept of the minimum required surplus is somewhat clearer in scenario 3. In this case the critical year for the C3 risk occurs rather early on in the projection period. Any amount sufficient to cover the expected deficit in the 5th projection year (year 25), will be ample to provide protection throughout the entire 40 year projection period.

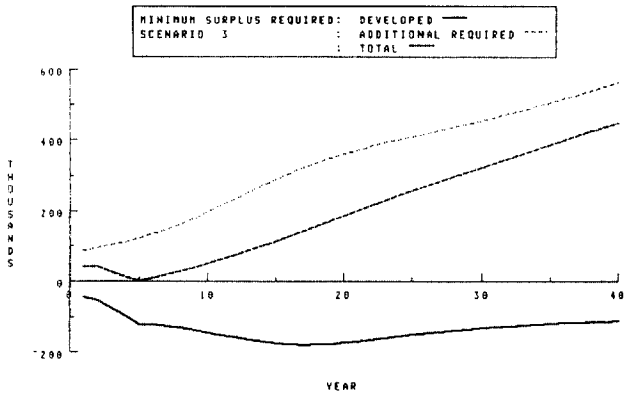


FIG. 8

Twelve scenarios in all were run. These covered three levels of volatility: 4%-25%, 4%-15% and 4%-10%. All projections started with a current new money rate of 15% and a reserve base of $2,830 thousand built up from the new issues historic period. The following table gives the basic characteristics of each of these runs.

TEST SCENARIOS

Year	Flat	4% to 25%			4% to 15%			4% to 10%				
	1	2	3	4	5	6	7	8	9	10	11	12
0	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
1	15	17	17	13	13	13	13	13	13	13	13	13
2	15	19	19	11	11	11	11	11	11	11	11	11
3	15	21	21	10	10	10	10	10	10	10	9	9
4	15	23	23	9	9	9	9	9	9	10	7	7
5	15	25	25	8	8	8	8	8	8	10	5	5
6	15	25	23	7	7	7	7	7	7	10	4	4
7	15	25	21	6	6	6	6	6	6	10	6	6
8	15	25	19	5	5	5	5	5	5	10	8	8
9	15	25	17	4	4	4	4	4	4	10	10	10
10	15	25	15	5	5	5	4	5	5	10	8	10
11	15	25	13	6	6	6	4	6	6	10	6	10
12	15	25	11	7	7	7	4	7	7	10	4	10
13	15	25	10	8	8	8	4	8	8	10	6	10
14	15	25	9	9	9	9	4	9	9	10	8	10
15	15	25	7	11	10	11	4	9	10	10	10	10
16	15	25	8	10	11	10	4	10	9	10	8	10
17	15	25	6	13	13	13	4	10	8	10	6	10
18	15	25	5	15	15	15	4	10	7	10	4	10
19	15	25	4	17	15	13	4	10	6	10	6	10
20	15	25	4	19	15	11	4	10	5	10	8	10
21	15	25	4	21	15	10	4	10	4	10	10	10
22	15	25	4	23	15	9	4	10	5	10	8	10
23	15	25	4	25	15	8	4	10	6	10	6	10
24	15	25	4	25	15	7	4	10	7	10	4	10
25	15	25	4	25	15	6	4	10	8	10	6	10
Etc.												

CHARACTERISTICS (figures in thousands)

Peak Growth: Reserves	2,988	2,830	2,979	3,279	3,279	3,279	3,279	3,279	3,279	3,166	3,374	3,374
Year	23	21	23	29	29	29	29	29	29	25	28	28
Peak Policy Loan: %CV	68.1	87.9	86.0	86.7	66.9	64.9	58.3	58.3	58.3	58.3	57.3	57.3
Year	24	26	25	44	39	38	23	23	23	23	23	23
Ending Inforce	157	157	262	271	271	469	636	452	700	719	760	417

The following table summarizes the results for this expanded set of interest rate scenarios. Because of the interplay of dividend philosophy with interest risk, the present value of future dividends as of the valuation date is also shown. Present values are based on the growth of $1 placed in the general account on the valuation date and are after FIT. Because each scenario results in a different discount rate, that rate is expressed in the table as an average annual after tax yield.

	60TH Yr. PROFIT OR LOSS INDICATOR			SURPLUS REQUIREMENTS				
SCENARIO	ENDING SURPLUS	PRESENT VALUE	% 20TH RESERVE	CRITICAL YEAR	PV SURPLUS NEEDED	% 20TH RESERVE	PV OF DIVIDEND	DISCOUNT RATE
1	250	11	0.39	21	42	1.49	1,512	8.1
2	-10,059	-95	-3.34	60	95	3.34	1,269	12.4
3	-114	-16	-0.57	25	81	2.85	1,336	5.0
4	1167	49	1.74	21	42	1.49	1,760	8.2
5	846	74	2.6	21	32	1.49	1,772	6.3
6	594	97	3.45	21	42	1.49	1,740	4.6
7	586	166	5.88	21	42	1.49	1,572	3.2
8	709	98	3.45	21	42	1.49	1,797	5.1
9	605	125	4.40	21	42	1.49	1,746	4.0
10	690	74	2.61	21	42	1.49	1,829	5.7
11	630	135	4.76	21	42	1.49	1,702	3.9
12	707	97	3.42	21	42	1.49	1,803	5.1

Under the tests described, only the two catastrophe scenarios show a loss over sixty years. The 1½% surplus deficit shown in the other scenarios is actually a result of the dividend design chosen and generally shows the yet un-matured state of the closed block of business under study. As no policy contributed to surplus until its 18th year, the block as a whole will not reach a positive surplus position until its 26th year, and this only if dividends are not pegged in the meantime. Only surplus requirements over and above the 1½% level are needed for the C3 risk. From the above table it appears that a special reserve at a level of 1.8% of reserves would be sufficient to cover the extraordinary interest rate risks associated with scenarios 2 and 3 while less extreme environments would primarily be reflected in lower profit dividend levels.

Finally, in order to place an absolute ceiling on the C3 risk should the lapse or loan assumptions used in the above study prove too optimistic, the market value of the assets at the end of each year in the projection period was compared to the unloaned cash values available. A market value deficit table showing the surplus required to cover 100% cash out is shown below. Present values are based on the future market value of $1 invested in the general account on the valuation date.

MARKET DEFICITS (figures in thousands)

	60TH YEAR				
Scenario	Present Value	% 20th Reserve	Critical Year	Surplus Needed	% 20th Reserve
1	11	0.39	21	247	8.71
2	-95	-3.34	22	338	11.96
3	-16	-0.57	22	338	11.96
4	49	1.74	21	137	4.83
5	74	2.60	21	137	4.83
6	96	3.39	21	137	4.83
7	166	5.88	21	137	4.83
8	98	3.45	21	137	4.83
9	99	3.48	21	137	4.83
10	74	2.61	21	137	4.83
11	109	3.87	29	140	4.94
12	97	3.42	29	140	4.94

Again only the two catastrophe scenarios show a market value deficit in the 60th year. A level of 4.8% deficit on the valuation date seems normal given the pattern of asset build-up and interest rate history during the issue period. The table shows the great volatility of market values over the interest rate spectrum and the vulnerability of this block in the short term. Surplus requirements at the level of 9%-12% are sobering indeed, but these levels must be considered against the likelihood of the 100% cash out at the point of peak vulnerability for which they would be needed.

CONCLUSION

This presents only the preliminary results in this study. Lapse and loan experience varies widely from company to company as do dividend philosophy and investment strategy. No one has dared yet, nor is likely in the future, to place probabilities on a set of interest scenarios. For these reasons there may be no hope for a general rule of thumb for determining the C3 risk for this product.

Discussion Note
Preliminary C-3 Risk Calculation for Individual Deferred Annuities
Prepared by James E. Feldman and Paul F. Kolkman

This report describes the set of calculations prepared by IDS Life for the Society of Actuaries Task Force to Study the Risk of Loss Due to Changes in the Interest Rate Environment. The basic methodology is that first used by James A. Tilley in studying the C-3 risk of guaranteed interest contracts. This methodology is described in the discussion note beginning on page 1368 of volume 7 of the Record. For convenience, the first two sections of that discussion note are reprinted below as the first two sections of this discussion note.

I. Purpose of the Calculations

The purpose of the calculations is to demonstrate a methodology for (1) testing a given reserve basis with respect to its adequacy for protecting against the risk of loss due to interest rate fluctuations, and (2) determining the amount of surplus needed to protect against that risk.

II. Nature of the Calculations

The adequacy of a given reserve basis can be tested by performing the following set of calculations:

A. Build up a sample company from scratch to a certain point in time according to a set of "historical" assumptions - interest rate path, sales volume for each product, pricing margins, cash flow experience, asset mix, etc.

   The certain point in time - "today" - will be referred to as the "valuation date." Times before the valuation date make up the company's past or history and times after the valuation date define the company's future.

B. Determine the statement value of reserves (SVR) and the book value of the assets (BVA) on the valuation date, and scale the latter up or down by a factor SRF (statutory reserve factor) to equal the former. This is equivalent to scaling the book value of each asset holding by the same factor and allows the company to be brought into a state of exact statutory solvency while preserving its asset configuration. Equivalently, this balance at the valuation date is achieved by drawing from (or releasing to) a surplus reservoir having the same asset configuration as the company, a block of assets with a book value equal to (SRF-1) x BVA.

C. Define a universe of future interest rate paths (commencing at the valuation date) and cash flow and asset mix assumptions for each path. The sample company is assumed to issue no new business beyond the

valuation date. Project the company from the valuation date along each interest rate path until the last contract matures, and liquidate all remaining assets at their market value at that point.

For each path, calculate the path sufficiency factor (PSF) that scales the BVA on the valuation date by the amount required to place the company in an exact break-even position at the time the last contract matures. The company will break even along the interest path if, on the valuation date, it draws from (or releases to) a surplus reservoir having the same asset configuration as the company, a block of assets with book value equal to (PSF-1) x BVA.

D. Let MSF (maximum sufficiency factor) denote the largest of all the PSF's. The interest rate path having PSF = MSF is called the "worst path" since it requires the greatest addition to (or least subtraction from) the assets existing on the valuation date in order to assume the company of breaking even.

If every one of the interest rate paths in the universe defined in item C is possible, and the paths in the universe are the only ones possible, the MSF is the smallest factor by which the BVA on the valuation date can be scaled to be assured that the company will break even. Hence, the valuation methodology described here is based on a maximum decision criterion.

A measure of the adequacy of the given reserve basis must take into account that the BVA on the valuation date must be scaled by SRF to achieve a "starting" balance on that date. The reserve adequacy factor (RAF) is equal to the minimum additional scaling of BVA required to assure a break-even result. Thus, RAF = MSF ÷ SRF.

A RAF ≤ 1 indicates that the statutory reserve makes sufficient provision to mature the obligations of the company along the worst interest rate path in the universe. A RAF > 1 indicates that the statutory reserve does not make sufficient provision to mature the obligations of the company along the worst path.

III. Sample Calculations

The model is constructed to examine the methodology as it applies specifically to individual deferred annuities. The specific product assumptions are contained in the next section.

A ten year historical period was selected as being representative of a mature block of business. The model has the flexibility to use any theoretical history, but "actual" historical interest rates through 1981 were used in these calculations. The mix of investments is fairly typical of that used by many companies over the past 10 years. New investments are fairly long in the beginning of the historical period and shorten dramatically as interest rates rise during the latter part of the period. For comparative purposes, results for two somewhat shorter investment strategies are also presented.

Any steps that company management might take in the face of increasing surrender rates to preserve the business are not presented. Such analysis was done and is discussed informally in section VI of this paper.

IV. Assumptions

A. The Products

The installment contracts are no load with surrender charges of 7% for the first 5 years, then decreasing by 1% per year until the charge reaches 0 in the 12th year. The single pay contracts are no load with a surrender charge of 7% in the first year, 6% in the second, decreasing linearly to 0% in the 8th year. Accrual rates are determined separately for each year's issues. The cash flow pattern of each year's issues determines an asset earnings rate for the block. The accrual rate is the asset earnings rate net of a profit and expense margin. This margin is 1.7% for single pay and 1.4% for installments. Current accrual rates are guaranteed for 6 months beyond the valuation date. Both products contain a 4% guaranteed minimum accrual rate.

B. Cash Flow

All cash flow is assumed to occur at the beginning or the end of the year. Premiums and expenses occur at the beginning of the year. Rollover (maturities and calls), investment income, and surrenders occur at the end of the year. Hence the net cash flow which is available for investment at the beginning of year t is:

$$\text{Prem}_t + \text{InvInc}_{t-1} + \text{Rollover}_{t-1} - (\text{Expenses}_t + \text{Surrenders}_{t-1})$$

Negative cash flow is treated as a disinvestment with the same asset mix as positive investments.

C. Reserves

Reserves are based on the 1980 amendments to the Standard Valuation Law. The reserve calculation assumes that the contract date and the valuation date coincide.

D. Asset Structure

Cash flow occurs annually and is invested (or disinvested) immediately. The investment possibilities are any mix of the following five asset types:

1. One-year par bonds with bullet repayment of principal.
2. Three-year par bonds with bullet repayment of principal.
3. Seven-year par bonds with seven equal annual sinking fund payments.

4. Fifteen-year par bonds with ten equal annual sinking fund payments commencing in the sixth year.

5. Twenty-year par bonds with bullet repayment of principal.

Single pay contracts are also examined with ten-year bullets instead of twenty-year bullets as investment type number 5.

The following table shows a typical mix of new investments at the beginning of each year.

Type	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981 and Later
1	0%	0%	0%	0%	0%	0%	0%	0%	20%	30%
2	0	0	0	0	0	0	0	0	20	30
3	0	0	0	20	20	0	0	20	20	30
4	20	20	20	20	20	20	20	20	20	10
5	80	80	80	60	60	80	80	60	20	0
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

The above mix is used in the calculations, and represents a dramatic shortening of investment strategy over the ten year period. An alternative strategy investing 100% of cash flow in asset type 3 is also used.

Call provisions are included for any principal repayment that is scheduled for 6 years after issue and later. The prepayment (without penalty) occurs at the same time the scheduled principal payment occurs. The percentage of the original face that is repaid depends on the difference between the coupon rate and the then current new money rate (CNMR). The prepayment rate is assumed to be as follows:

0	when	CNMR $>$ (Yield - 2%)
.10	when	(Yield - 2%) $\geq$ CNMR $>$ (Yield - 4%)
.15	when	(Yield - 4%) $\geq$ CNMR $>$ (Yield - 6%)
.20	when	(Yield - 6%) $\geq$ CNMR $>$ (Yield - 8%)
.30	when	(Yield - 8%) $\geq$ CNMR $>$ (Yield - 10%)
.50	when	(Yield - 10%) $\geq$ CNMR

E. Asset Yields

All yield curves are assumed to be level, that is, short, intermediate, and long term rates are the same. The historical rates are Moody's composite yields on seasoned corporate bonds and are as follows:

1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
7.81	7.59	8.22	9.54	9.42	8.61	8.64	9.50	11.51	13.71

Interest rates for the 15 years of the projection period proceed along ten possible paths. These new money interest rate scenarios are:

	Projection Year (%)														
Path	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
2	15	17	19	21	23	25	23	21	19	17	15	17	19	21	23
3	15	13	11	13	15	17	19	21	23	25	25	25	25	25	25
4	15	12	15	18	21	25	25	25	25	25	25	25	25	25	25
5	15	17	19	17	19	21	19	21	23	21	23	25	23	25	27
6	15	17	19	21	23	25	25	25	25	25	25	25	25	25	25
7	15	18	21	25	25	25	25	25	25	25	25	25	25	25	25
8	15	13	11	9	7	5	3	3	3	3	3	3	3	3	3
9	15	11	7	3	3	3	3	3	3	3	3	3	3	3	3
10	15	17	19	17	15	13	11	9	7	5	3	3	3	3	3

F. Withdrawals

Withdrawals are a function of the difference between the accrual rate and the new money rate. If non level yield curves were assumed, the withdrawal rate would depend on the highest of the new money rates. The amount surrendered is the percent calculated by formula times the contract value less any surrender charges. The surrender rate cannot exceed 75% in any year, except in the 15th projection year when all funds are assumed to be withdrawn. The moderate surrender rate is:

$$F_1 + F_3 + .01 \times (100 \times D)^{F_2}$$

where D is one percent less than the difference between the current new money rate and the accrual rate for each block of business, but not less than 0. F_1 and F_2 are specified in the following table:

	Single Pay	Installment
F_1	.05	.07
F_2	1.5	1.4

F_3 is a retirement factor equal to duration from issue divided by 15 minus 1, but not less than 0.

The high surrender rate is the moderate rate times 2.

G. Company History

There is a ten year historical period. For single pay contracts sales in the first historical year are $10,000. Sales in each succeeding year are assumed to be increased as the CPI. The premiums are shown in the following table:

1972	1973	1974	1975	1976
10,000	10,430	10,774	11,442	12,701

1977	1978	1979	1980	1981
13,857	14,660	15,613	16,800	18,732

Gross annual premium issued for installment contracts has the same growth rate as single pay sales. Renewal premiums are assumed to be a percentage of the initial premium still inforce, according to the following payment persistency schedule.

Contract Year	1	2	3	4	5	6+
Payment Persistency	1	.9	.8	.7	.6	.5

H. Expenses

Expenses are assumed to be 9% of premium received for the first contract year, 5% of premium for the next 5 years, and 3% of premium thereafter.

I. Federal Income Tax and Shareholder Dividends

Federal Income Taxes are ignored in these calculations. No shareholder dividends are assumed to be paid.

V. Presentation of Results

Below are the reserve adequacy factors (RAF) for each of the ten interest rate paths with the highest RAF for each set of product assumptions underlined. The reference numbers on the left refer to the following sets of product assumptions.

Ref No.	Product Assumptions
1	Single Pay - moderate surrenders - 20 year bullet for asset 5
2	Single Pay - moderate surrenders - 10 year bullet for asset 5
3	Single Pay - moderate surrenders - 100% investment in asset type 3
4	Single Pay - high surrenders - 20 year bullet for asset 5
5	Single Pay - high surrenders - 10 year bullet for asset 5
6	Single Pay - high surrenders - 100% investment in asset type 3
7	Installments - moderate surrenders - 20 year bullet for asset 5
8	Installments - high surrenders - 20 year bullet for asset 5

Ref. No.	Reserve Adequacy Factors									
	1	2	3	4	5	6	7	8	9	10
1	1.08	1.28	1.12	1.24	1.24	1.33	1.39	.94	.94	1.06
2	.94	1.02	.93	.98	.99	1.02	1.06	.96	.98	.99
3	.89	.91	.90	.91	.91	.92	.92	.93	.97	.91
4	1.43	1.88	1.48	1.58	1.74	2.01	2.20	1.02	.96	1.36
5	1.10	1.18	1.05	1.10	1.15	1.18	1.23	1.07	1.02	1.15
6	.94	.96	.94	.95	.96	.96	.98	.94	.97	.95
7	.90	1.08	.96	1.05	1.03	1.10	1.15	.89	.94	.91
8	1.11	1.34	1.15	1.29	1.30	1.39	1.45	.94	.90	1.06

VI. Discussion of Results

A. Cash Flow

Having sufficient net cash flow in each year is critical to the safety of these product lines. For the products we are examining, investing entirely in one year bonds will generate sufficient cash flow. This does not necessarily maximize company profitability or rate of return to the customer. In general, as interest rates rise, the liabilities shorten dramatically, and the shorter the duration of the assets, the better the results are. The opposite often holds true in a declining interest rate scenario.

Negative net cash flow, which is treated as a loan rather than selling of assets, aggravates the problem in rising interest periods. Borrowing at high rates of interest pulls the asset earnings down for a particular cell, and therefore the accrual rate is lowered. This causes more surrenders, according to the assumed formula, which further increases the cash flow problem. As long as the overall asset rate is sufficient to support the 4% guarantee plus the desired pricing margin, however, the product remains "profitable" as measured by a statutory income statement.

B. Installments

The results show that in similar situations, installment RAF's are less than single pay RAF's. This is largely due to the continuing installment cash flow generated through renewal premiums. This implies that a safe investment strategy for installments can be somewhat longer than a safe investment strategy for single pay.

C. Cutting Margins

One way to reduce surrenders, thereby increasing cash flow, is to reduce the profit spread when interest rates rise. We tested several scenarios with modified spreads and found only a very slight improvement, even with judicious accrual rate setting.

D. Effect of New Business

Business issued near the end of the historical period tends to have a RAF of less than one because the assets underlying the liabilities are short enough to handle even the rising interest paths. The reserve adequacy generated by these issues could be used to offset the reserve inadequacy from some of the earlier issues. Theoretically, if enough new business could be issued, the reserve adequacy of the later issues could completely offset the reserve inadequacy of the earlier issues. The entire block of business, therefore, could have a RAF of less than one. This scenario ignores any growth surplus that would be required to write the business.

E. Surplus

The RAF's are determined by scaling up or down the entire block of assets. The surplus could be invested according to the investment strategy for the current year rather than that of the historical period. This action would have a moderating effect on the RAF's.

F. Cash Flow

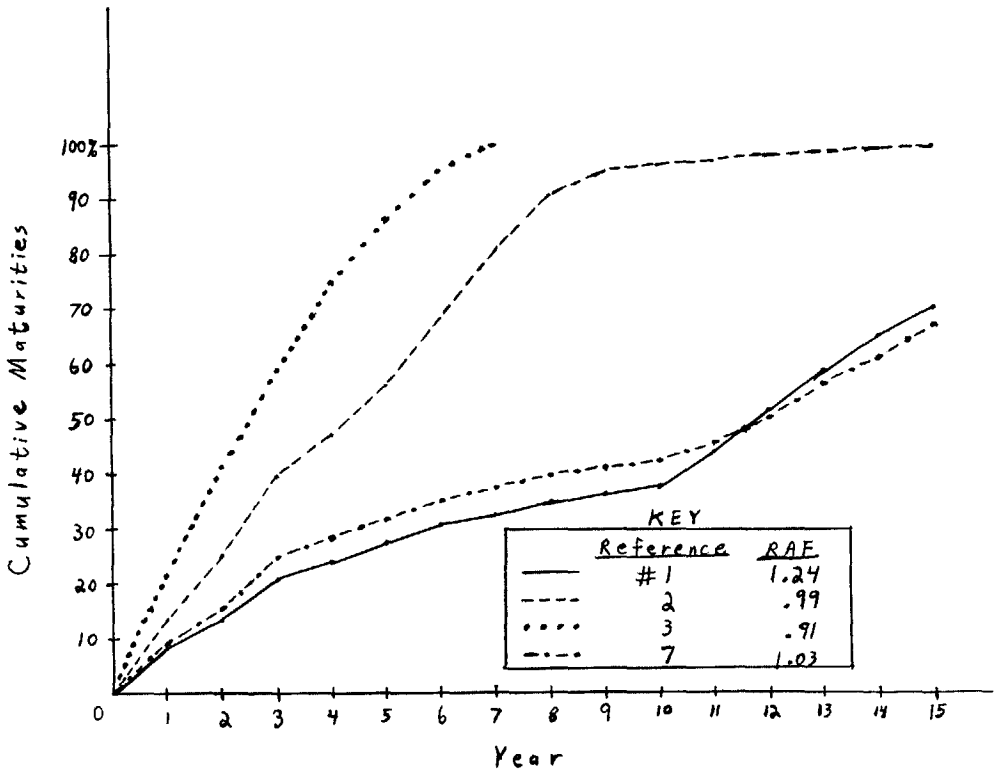
The relationships between cash flow and the RAF's can be best illustrated by looking at an individual cell. Consider the reference numbers 1, 2, 3, and 7 from the preceding section. Also consider business issued in 1976. These individual cells have RAF's of 1.24, .99, .91, and 1.03, respectively. The net cash flows, and resulting accrual and surrender rates are presented in a table below. Note that net cash flow in 1983 and later reflects the inclusion of surplus.

		Reference #1			Reference #2			Reference #3			Reference #7		
YEAR	INT RATE	NET CASH FLOW	ACCRUAL RATE	SURR RATE	NET CASH FLOW	ACCRUAL RATE	SURR RATE	NET CASH FLOW	ACCRUAL RATE	SURR RATE	NET CASH FLOW	ACCRUAL RATE	SURR RATE
1976	9.42	11558	7.72	5.59	11558	7.72	5.59	11558	7.72	5.59	11558	8.02	7.28
1977	8.61	708	7.67	5.00	708	7.67	5.00	2029	7.58	5.00	10559	7.63	7.00
1978	8.64	795	7.62	5.00	795	7.62	5.00	2395	7.46	5.08	8987	7.51	7.06
1979	9.50	811	7.63	5.81	811	7.63	5.81	2733	7.52	5.97	7546	7.62	7.83
1980	11.51	745	7.75	9.58	745	7.75	9.58	3028	8.04	8.88	6218	7.97	10.68
1981	13.71	407	7.86	15.69	407	7.86	15.69	3125	9.02	12.08	5320	8.40	14.73
1982	15.00	181	7.88	20.14	-240	7.70	20.80	2785	10.23	12.31	4214	8.68	17.37
1983	17.00	-170	7.74	28.74	-871	7.07	31.67	3279	12.14	12.59	3789	9.02	22.19
1984	19.00	-1450	6.55	43.76	-2466	4.06	57.05	2393	13.58	14.29	1466	8.97	28.76
1985	17.00	-2796	4.35	44.75	-4676	4.00	46.57	2380	14.36	7.10	-2281	8.32	24.34
1986	19.00	-2340	4.00	57.38	3327	4.00	57.38	3462	15.57	8.78	-976	7.92	32.38
1987	21.00	-2422	4.00	69.00	-85	4.00	69.00	3547	16.94	10.37	-3627	6.48	45.32
1988	19.00	-2486	4.00	57.38	-1318	4.00	57.38	3618	17.29	5.60	-7779	4.00	47.23
1989	21.00	-1992	4.00	69.00	866	4.00	69.00	4594	18.08	7.65	-6636	4.00	55.50
1990	23.00	-1950	4.00	75.00	305	4.00	75.00	4778	19.17	9.75	-6483	4.00	64.20
1991	21.00	-2067	4.00	69.00	-301	4.00	69.00	4892	19.34	5.53	-7116	4.00	55.50
1992	23.00	-2300	4.00	75.00	99	4.00	75.00	6319	20.08	13.81	-6510	4.00	66.58
1993	25.00	-2502	4.00	75.00	244	4.00	75.00	5352	21.04	22.08	-6806	4.00	75.00
1994	23.00	-2828	4.00	75.00	-41	4.00	75.00	3755	21.24	24.53	-7847	4.00	71.36
1995	25.00	-3220	4.00	75.00	-14	4.00	75.00	3327	21.79	32.75	-8704	4.00	75.00
1996	27.00	4545	4.00	100.00	81	4.00	100.00	1711	22.35	100.00	-2600	4.00	100.00

Cells 1 and 2 each credit approximately the same accrual rate and suffer the same surrender problems. Yet because cell 2 has a positive net cash flow in 1986 when the original invested assets mature, the remaining net cash flows are moderated and reserve adequacy is demonstrated even though the experience is dismal. Cell 3 has relatively steady cash flow, and has good experience. Cell 7 relies on the renewal premiums to keep cash flows high in the early durations and therefore has a lower RAF than cell 1.

G. Rollover

The following graph shows the cumulative maturity schedule as of the valuation date for the same four cells, 1, 2, 3, and 7. This schedule has been developed from the cash flow and investment activity during the historical period. This graph shows that the shorter the duration of the assets, the lower the RAF. The maturity schedules for cells 1 and 7 are quite similar even though the RAF's are greatly different. This difference in RAF's is a result of the continuing renewal premiums in cell #7.



VII. Acknowledgement

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