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## Session 75PD Phase 2 Of The C-3 Project Update

**Track:** Investment

**Moderator:** ALASTAIR G. LONGLEY-COOK  
**Panelists:** ALASTAIR G. LONGLEY-COOK  
DANIEL R. PATTERSON  
DAVID K. SANDBERG

*Summary: Attendees learn the status of the second phase of the AAA C-3 Risk project. This project is leading to an updated NAIC filing requirement and is a step toward fair value. The specific focus is on equity risk and bond funds in the distribution tails. Products covered include variable life and annuities.*

**MR. ALASTAIR G. LONGLEY-COOK:** In this session we're going to get into the proposed changes to the C-3 RBC requirements, so called C-3 Phase 2. I'm going to talk a bit about the issues and implications of the proposal, and Dave Sandberg will talk about how it fits in with the trends in the international regulatory environment and other moves towards scenario analysis and fair value.

Dan Patterson will then conclude with application to company practice.

For those of you who don't know me, I'm Alastair Longley-Cook. I spent most of my career at Aetna, where I retired at the end of 2000. I've been with Tillinghast for the last year and a quarter. I also chair the Academy's Life Capital Adequacy Subcommittee, which some of you may have known in the past as the Risk-Based Capital Task Force.

What the committee does in its various subgroups—particularly Bob Brown's subgroup that does all the nuts and bolts work on C-3 and on Phase 2—is make recommendations to the NAIC, in particular the Life and Health Actuarial Task Force

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**Note:** The chart(s) referred to in the text can be found at the end of the manuscript.

(LHATF), and they're meeting next week in Philadelphia. They'll be discussing these issues. I will introduce Dave and Dan as they come up. So without further ado, let's get into Phase 2.

This presentation is based on the recommendation that the Academy subcommittee I just mentioned made to the NAIC, and it is the recommendation with regard to variable products with guarantees. Now, it doesn't include index guarantees. What we are talking about here are guaranteed minimum death benefits (GMDBs) and the variable annuity guaranteed living benefits (VAGLBs) that you've been hearing about through Quad M perhaps—guaranteed minimum income benefits (GMIBs) and guaranteed minimum accumulation benefits (GMABs).

### **History**

The history here is one of a transition from formulaic approaches. Several years ago the NAIC asked the Academy to take a fresh look at the C-3 factors, so that the standards would reflect the actual assets and liabilities of the specific company. In December 2000, the NAIC implemented Phase 1, which applied to annuities and single premium life. Nonexempt companies were required to run 50 scenarios, which were the worst scenarios we found out of 200. The model, the interest rate model, was put on the Web; so you had to use that model. But you used your own assets and liabilities, and the standard was set at the average of the 92<sup>nd</sup> through 98<sup>th</sup> percentile. The key metric was the worst surplus in any one year in each scenario, discounted back at the short-term rate.

That same subcommittee then was asked to look at variable products with guarantees, so it's expanding C-3, which has always been thought of in terms of interest rate change risk, to what we could call asset liability tracking error—times when the assets and the liabilities don't move together. Interest rates can drive that, but so can changes in the equity and interest rate markets when you have guarantees in variable products.

### **Recommendation**

In Phase 1, there was a specific interest rate scenario generator required. In Phase 2, we're taking the approach that we should not dictate (When I say "we," I mean the regulation, the NAIC,) what model to use. There are too many equity models out there being revised all the time. You have regime-shifting models, different distributions, use and nonuse of mean reversion. So we did not want to dictate the model.

So instead, if this proposal is adopted, the actuary in the company doing this calculation would use whatever model he or she deems appropriate; but we would require that it validate—in particular that it has so-called fat tails. The concern is since these risks only emerge out in the tails, if you have a scenario generator that does not have tails fat enough to be representative, particularly equity markets, then you will be understating the risks in those tails.

The same statutory surplus standard is used here. The lowest of those present

values is tabulated, and the scenarios are sorted on this measure.

Because these risks emerge far out in the tail, if we just said, "Set the standard at 95 percent," then you could have a situation where at 95 percent, there is no required surplus, but at 97 percent, there's a significant need for surplus. So what we are proposing is so-called 90 percent CTE, which is the average of the results in the worst 10th percentile.

This is consistent with the segregated capital requirement now used in Canada. The proposal was made by the Canadian Institute of Actuaries (CIA) and adopted by Office of the Superintendent of Financial Institutions (OSFI)—although they moved it up to 95 percent CTE, it's consistent with that—says your risk-based capital (RBC) requirement would be based on 90 percent CTE, the average of the results in the worst 10th percentile. For 95 percent CTE adopted by OSFI, the RBC requirement would be based on the average of the results in the worst 5<sup>th</sup> percentile. Then take whatever assets are needed to cover the average of the worst results, subtract reserves, and what is left is the surplus requirement.

Reinsurance and hedging would receive credit. The standard in Canada is that they give up to 50 percent credit. I'm not sure where we'll come out on this, but we want to encourage hedging; so you should be allowed to reflect that on your models. But since there is usually basis risk or other error in the hedging, you may not get 100 percent credit; but you should get enough to encourage that kind of hedging in your risk mitigation.

### **Outstanding Issues**

I'd like to spend some time on the issues still to be resolved, which Bob Brown's task force is working on.

**1. Calibration.** First, the calibration requirement for interest rates and equity returns. Clearly you need a scenario generator that will generate equity returns, because, obviously, only when the equity markets are down do these guarantees come in the money. You need to make sure that those validate according to fat-tail requirements.

The proposal has requirements for the 2.5th, 5th and 10th percentiles. You would run your model against the S&P 500 and Ibbotson small-cap distributions. What they historically have shown are those percentiles. If you are at least as fat at those points, then you have validated your model.

You then can use your model to project scenarios for the funds backing your policy. So you may have the S&P 500 and Ibbotson small-cap, but you might also have NASDAQ or some other set of funds. If you've validated against S&P 500 and Ibbotson small-cap, then your model can then be used for those other ones as long as they don't violate finance theory. In other words, if you say, "OK, my model just validated S&P 500, but I've got this super-duper fund that has greater returns

and less volatility," that's going to be looked at suspiciously by any regulator reviewing documentation of your RBC standard.

You then need to project interest rates for GMIBs, because when those guarantees are in the money due to lower equity returns, you need to make sure your company is meeting the interest rate margins that are in the income guarantees.

So ideally you would be also running interest rate scenarios. Now, one way is to run 10,000 equity scenarios, and at each point that your guarantee is in the money, you'd run another stochastic generation of interest rates. That's clearly not the most efficient way to do it. What so-called cascade models or internally consistent models do is project out not only, say, equity returns, but also interest rates at the same time. Using stochastic differential equations, you cascade one parameter off another, allowing for a link, but also allowing for a stochastic behavior of that other parameter.

So if you have 1,000 scenarios of 20 years worth of equity returns, inside of those is also going to be all your interest rates or whatever other parameters that you need.

There are scenario generators out there that do that. Tillinghast has Global Cap Link. Other consulting firms and other investment banking companies and firms have theirs. Creating your own is a lot of work. I know some individuals and companies have done that.

So what we have talked about doing is allowing a more simplified approach for those companies that do not run those kinds of sophisticated scenarios, and we need to work out the details; but it would allow for, say, assuming the interest rate as of the start of your run, and as long as you have enough conservatism in your assumptions, that may be adequate.

The other issue here is what interest rate you use to discount. Ideally you would use the interest rates in that scenario. If you're not running those more sophisticated models, we're saying you can use the short-term rate that's consistent with the yield curve as of the start of the projection. So there is still work to be done there, but those are some of the issues.

**2. Alternative Simplified Model.** Not every company is going to be wildly enthusiastic about the stochastic scenario requirements. They have to start running 1,000 or more scenarios to come up with the RBC standard, particularly if they don't sell a lot of the stuff. So we are analyzing simplified methods where maybe we shock it down, shock it up, and get a feel for the sensitivity. Maybe that's allowed, and maybe that's satisfactory if you don't sell a lot of the guarantee or the guarantees are not particularly aggressive—and you can live with the result.

**3. Regulatory Review, Approval.** The details need to be worked out regarding

regulatory review and approval. This may end up looking something like the memorandum for asset adequacy analysis, maybe not.

The idea is that you are documenting and justifying what you did; and again, there's this movement from factors to scenarios—deterministic scenarios in Phase 1—to stochastic scenarios wherein the actuary who is signing off on this is making a lot of decisions about the models, the assumptions, etc.

Clearly the regulators cannot take that on complete faith. They need to be able to go in there and say, "OK, what did you do, why did you do it?" So we will need the documentation and sign-off standards of practice. So this clearly will be more than just a tick and tie calculation each year.

**4. VUL Included?** The issue of whether variable universal life (VUL) is to be included is still being decided, but it looks to us on the committee that it will not be included.

In Phase 1, we included single premium UL; but when we ran UL, the margins swamped any problems with the annuities. Those of you who design universal life policies, as I used to many years ago, know that you got all kinds of sources of profit there, so when you get into trouble, you really aren't in a whole lot of trouble. If you allow companies to aggregate UL with annuities, RBC is going to be zero every time.

We've been doing some testing of this at my firm for the committee, and so far, we've found the same thing. We haven't finished that analysis, but my guess is that the UL will probably not be included.

**5. Credit Allowed for Hedging.** The credit that should be allowed for hedging is something that I've talked about. That needs to be resolved, and we frankly haven't done a whole lot of testing yet; so that's probably going to be one of the ones that gets addressed toward the end of this analysis.

**6. Testing.** We are doing testing on methodology and results. We have several members on Bob's subcommittee who are running this on some model offices and seeing how it comes out.

**7. Statutory Surplus.** The requirement that we used in Phase 1 and that the NAIC is looking for us to use is that at each year in the projection, you must calculate statutory surplus. Well, statutory surplus requires calculation of statutory reserves, and you have to make sure that you are technically solvent, even though in the long run, you've got enough assets, but at that point were you technically insolvent?

Those of you who have worked with CARVM know that it's a strange animal that requires you to kind of take a look at the worst case, the greatest present value.

And specifically with regard to these guarantees, you have under AG 34 this deterministic shock; and under the proposed Quad M that Tom Campbell's task force has been working on so hard these four years, you have another deterministic shock and recovery. But it has that built into it.

In running these tests to see how this came out, if you floor the reserves using CARVM, using AG 34, using Quad M, that puts an additional level of conservatism in there that makes the resulting RBC very volatile and very large.

Now, is it too large? You could argue, "Well, maybe if that's the requirement, that's the result." But relative to what your requirement would be if you didn't floor it, it's like two to three times. And that gives us pause.

Should the risk based capital requirement for these products be 8 to 10 percent? A gut reaction says that would be that sounds awfully high; but more specifically, if it's one percent or two percent without the floor, and it goes to six percent or eight percent with it, then it's caused a lot of reviewing of what's going on here to figure out whether or not that's the right result.

Now, we're still trying to figure out why that is. My own view is that if you think about a whole lot of stochastic runs—you know, you've got all these runs, and some go down, and then come up; and some go up, and then go down and all of this. So in the runs where things go down and then come back up, you've got enough assets, but you have a little period in there where you're statutorily insolvent, that's not so bad. But if at those points you have a reserve requirement that assumes a deterministic additional downturn, you can see how that could magnify the sensitivity here. I think that's what's causing it, and so the question is then raised, "Well is that right? Is that appropriate?"

This came to a head several weeks ago, I guess about a month ago now, in a conference call with Larry Gorski's Risk-Based Capital Working Group and Tom Campbell's Quad M committee.

The issue was raised about what Quad M was doing to C-3 Phase 2. There were also other concerns about Quad M, a general discomfort among the regulators about whether or not this really was a good permanent solution.

There also was this general feeling among LHATF that we had this Universal Valuation System Task Force that Dave Sandberg chaired so well for a while, that didn't end up going forward because of the enormity of it and the implications around taxes and the rest of it. But the theory is still an attractive one and one that's consistent with the way the Canadians came out. And we've got this sort of S-curve of cumulative probabilities, and maybe you put the RBC standard at 95 percent on that and the reserve standard at 83 percent on that, and everything's consistent and flows together and you don't have this problem.

As a result, Larry and his task force asked the various Academy committees to go back and take another look.

So I don't think it's stretching things to say that at this point, Quad M is off the table. Next week in Philadelphia, Dave, Bob and Tom will be making presentations to the LHATF on those three issues—Quad M, Phase 3, C-3 Phase 2 and the long term perspective. It will be very interesting to see where this goes, so stay tuned.

I think Phase 2 will move forward, but we need to resolve this problem before it can. We may end up with a temporary solution for Quad M to either use in this or in general. We may have one requirement for the reserves and then use a different one in the calculation of RBC. These are things that they're watching, and hopefully there will be some decisions made before we all have to actually do the work. But as you know, sometimes these things do move a little slowly.

Dave Sandberg is corporate actuary of Alliance Life, the most recent of many positions he's held. But as many of you know, he's extremely active in the Academy, also the Society. He's also a member of the International Actuarial Association's (IAA's) Insurance Regulation Committee, and he is vice chair of the Academy's Life Practice Council. He's going to speak to us about the international view.

**MR. DAVID K. SANDBERG:** This is a topic that's really timely, so it's always nice to find some way to undermine all those advanced deadlines. So we needed to make sure we had something that's fresh and moving, both on the national and international levels, things are rapidly moving.

We're in an era in which there's a lot of concern about adding value in the business process; and adding value requires a few things. It requires, I think, as individuals and as companies and as countries, that we be able to sit back and realistically assess what we're up to, because we face the paradigm with the question being, no matter what we've done in the past, what are we doing going forward that's adding value to the current situation?

It opens us up to the idea that we might have to change, we might have to look at some new solutions, and we might have to make sure we understand what our core competencies are and stay focused on those.

Well, that process is going on not only within individuals and companies; it's also going on within our profession. I think this is a great opportunity for our profession to be able to contribute and say, "Here are some areas where we can add value." Regulators themselves are going through the same process.

For example, in the question of state versus federal regulation, what value does each have? I think there's a lot of sometimes sentimental support by companies for federal regulation, because the grass is always greener on the other side of the

regulatory fence. On the other hand, I look at federal regulation of health and pension, and I don't get a comfortable feeling about what it implies. You get just as much diversity between federal agencies that claim jurisdiction over certain elements as you get concerns about states saying, "Well, we're going to have different standards."

So part of this is to give some larger context of what's going on within our country and what's going on in other places; because they're also dealing with these questions. So what's going on in Canada, Australia, England, European Union and the International Actuarial Association?

### **Canada**

First, Canada: They have a guarantee of a floor to a mutual fund at a point in time. I'm going to buy a mutual fund, and I want a guarantee that seven years out, I'm going to get at least 75 percent of what I put in. That was how this started, I guess five to eight years ago in Canada.

At first, it was not a very expensive kind of addition, it wasn't a very big deal. But then it started to become competitive, and soon you were getting 100 percent guarantees; so people became concerned and were asking, "Are we really capturing the capital costs for these fairly rich guarantees?" Now, this is a simpler kind of deal than we have here, because all you're saying is that a mutual fund guarantees some minimum level in cash at some future point.

Starting in 2002, OSFI is allowing the use of internal models to determine the capital requirements. Now, to get approval for that model, they have a strict approval process that says you have to meet the associated risk management program requirements for the internal model to be approved.

Now, what they're trying to accomplish in this process is that they want the company to have a risk management culture as opposed to complying with a rule that says to hold two percent or whatever it might be. They're using this kind of product as a springboard for how they're reviewing risk management and assessing risk management in companies as a whole. It's kind of the first step in saying, "How far can we push this, and as we do, how do we have to think about this process?"

So they're looking at the role of the actuary. As Alistair mentioned earlier, this is an evolving role for the actuary to perhaps a risk-based capital actuary role. OSFI has just recently completed an interview with CEOs and CFOs of all their major organizations and said, "Tell us how you think the actuaries are working in the role that they're performing. Do you think you're getting value out of that role?"

They're assessing that. They haven't finished the conclusions, but they're interested in how this is working and how the actuary can contribute to the successful regulation of insurance organizations.

What else is going on in Canada? It's been helpful in the United States to see another regulatory group explore and go down this road of using internal models to assess capital.

The other interesting thing that's going on is this larger risk picture. They also have dynamic capital adequacy testing. You look at your new business plan and project it out for the next several years and make sure that your capital is still adequate under that role.

They wanted to have high standards for these reports. You know, right now, you have this interesting process. Some of you have written many actuarial memorandums, but you may have only gotten a handful of feedback from anybody other than the regulator within the state that you file it with. You may not have much discussion about it. Are they any good or not?

So Canada has decided to start grading the reports. They don't mean this in a policeman role; they mean it as feedback to make the reports better, because they realize the person doing it gets very little feedback. How can they get better without the feedback? This year, for the first time, they've taken on the responsibility to say, "We're going to have a central group that gets together, a few people that read all of them and then start finding a way to assess them and give the feedback to the people as a way of improving the process."

Now, what are the reports from the trenches, from the companies that have had to deal with this? This is a new requirement in 2001. It is going on this year and will continue going forward.

Well, first of all some companies said, "Gee, these are really stringent requirements." But Canada, the regulator at OSFI, said, "That's OK, we like it that way." Some companies have left the market due to the higher capital requirements and the earnings volatility they've experienced. This has led to some suggestions for dealing with the volatility, such as averaging your last four quarters of results.

OSFI is very open to the issue. They're not trying to say, "We're in charge here." They're saying, "If we've got some reasonable solutions let's explore them," because they understand we're really trying to look at a long-term picture. We're trying to make sure that we're funding over time for something that may be happening in the future. We're not trying to establish so much a value as a direction.

It's also true that Canadian companies who write in the United States must meet the Canadian standard. So they're already dealing with our C-3 Phase 2 products in their valuation standard this year. So even though we're still saying, "We're not quite sure how to do it; we're not sure quite how we're going to land on it," it doesn't matter for a Canadian company that owns a U.S. company. They have to

meet the Canadian standards.

There can be some large modeling that needs to happen. This is from Geoff Hancock, who is a consultant in Toronto, who worked for companies on this project. Their biggest case has required seven and a half hours to do 1,000 scenarios. It's a quarterly evaluation that goes out 30 years—a quarter of a million policies; but this is the exception.

Where are the benefits as seen from the company perspective? They have better models and they have sounder product design, pricing and risk management processes. One of the actuaries did mention to the regulator, "You know, after having gone through this, we now realize that we were in a product that we shouldn't have been in, and we're now out of it." It allowed them to be able to tell their management, "We shouldn't be in this in the first place."

It's also encouraged them to think more clearly about their hedging. Again, they're encouraged by what they're seeing, but they still need to get a better understanding of how to manage and model the hedging aspect of the process.

### **Australia**

This is new for this year. This is prompted by the insolvency of one of their largest P&C writers, and they have established the option of internal model for solvency setting. Now, again, this is brand new for this year. What they're saying—and this is an important distinction—they have factors for their RBC levels, but those factors are set based on the assumption that the reserve is based on first defining a central claim point or a best estimate and then increasing it to a 75 percent sufficiency level.

Now, this law applies to general insurance P&C business, which I tend to think of as probably a little more complex process than doing this for a life insurance product or an annuity product. But they feel comfortable that they're able to go ahead and say they're going to let this be based on a company-specific risk judgment of what the reserve level is, assuming the model meets certain criteria such as being used in the company's business decisions, has been validated, etc. And then on top of it they add the factor to get the RBC.

Now, we're suggesting in the C-3 Phase 2 project that we do the economic internal assumption-based model for the RBC, and then we can scale down the reserve level after that. But you can approach it either way, if you're saying that we're really trying to get at the economic operations or economic impact of this insurance benefit.

Now on the life side, since '98, they've set their assets at market. This is for solvency regulation. The liabilities are net present value, which includes some Provisions for Adverse Deviation (PADs). Now, as they change those PADs, they change the core assumption. You can liken it to unlocking. Instead of where we

unlock under FAS 97, and recognize it immediately, in Australia, they— amortize that new change over the future life of the business. So you may get a series of pluses and minuses that start getting written in over the life of the business.

### **Europe**

So now we move to Europe, a more traditional arena. The U.K. has a very simple solvency standard. It's basically four percent of reserves.

Now, they recognize that this is not up to snuff, if you will. There's a national review underway. But they're also aware that the European Union is going through a similar review, because most European countries have standards very similar to this—very simple requirement for solvency.

So the European Union has just finished what's called Solvency II project and came to a list of conclusions as they start moving toward their 2005 timetable.

First of all, they recognize that factor-based approaches do not provide a comprehensive framework for recognizing all the types of risks. Probabilistic models are theoretically the best tools. Now, this may sound obvious to many here, but this is a public regulatory body saying as a group, "We are agreeing this is where we want to go; this is the value that we need to use." So this is a significant statement. I think you can appreciate the context.

They, of course, recognize practical issues. It's kind of like the unified valuation system (UVS) discussion here in the United States in the last couple of years, jumping full-bore into everything in the company being based on an internal model is a pretty dramatic step. So maybe we need to think through how we isolate and identify areas that are of the most value and in which we can see the most benefit as we start and then unfold a step at a time.

So the Solvency II report proposes a system that has strong emphasis on scenario test approaches with a nice balance of practicality and effectiveness. They even suggest a possible approach of allowing three choices for a company to use:

1. A fully codified factor based approach
2. A scenario-based approach with a predefined scenario set. This could be somewhat like the C-3 Phase 2. Pre-defined scenarios with calibrated fat tails.
3. Then the last one is an advanced model approach, using a full probabilistic basis.

Once you choose an option, you can only go in the direction of more advanced approaches. Again, the idea is to encourage movement toward more powerful techniques. The regulators want to feel like companies are starting to understand and get value for the knowledge that they have about their business and the ability to understand it, model it, communicate it and manage it.

**International Actuarial Association**

In the meantime, two years ago the International Actuarial Association decided to develop a working party to address solvency. The question was raised, "If an actuary could approach this, how would he or she go about doing it?"

Well, the first major decision that we made was to call ourselves a working party. In the United States we create "task forces." Here, we wanted to make sure we work hard, and we wanted to also include the enjoyment aspect of it, too.

Next, we wanted to look at what kind of risks insurers are subject to. We cataloged how banks look at it, how different countries organize their risks, and the approaches you can use to model those risks—where to get the needed data, and how to look at the interaction between the risks.

We looked at techniques for analyzing the tail of a distribution. The CTE concept is one that was developed with Canada, but that was brought into this paper, so it was communicated to a wider body. Additional issues include time horizon for catastrophic portions of the distribution, some ideas on interaction and correlation, and then what that means for regulatory capital requirements.

So in this paper, there are probably about 40 pages or so of text and concepts that are talked about and then another 60 pages of about a dozen examples ranging from insurance to general insurance kinds of products to illustrate and reveal, "Here's some probabilistic ways to assess and quantify these risks."

We presented this paper to the solvency committee of the International Association of Insurance Supervisors last October, and they found the concepts interesting. So they proposed that we continue the project and look at a risk-based solvency capital structure for insurers.

We just had our last meeting last week in Toronto. We plan to have a first draft of this paper done by the October IAA meeting to discuss with the parent insurance regulation committee and then present it in November to the IAA solvency committee.

The paper needs to consider and look at structures that might be adopted for a risk-based solvency capital system that could be adopted by regulators in many different territories. So we are trying to be able to think about the core that's needed in a capital requirement process, to describe the principles and methods that are needed and to be specific and practical enough that it could be based on principles and methods that can be used as a foundation for a risk based solvency capital system.

There is an increasing desire to make sure there's some common way that—if I look at a company in Germany, and I'm in the United States—I can be assured that I can take at face value their regulatory approval of this company and that it's not

going to be a risk for my U.S. company to interact with them.

This requires defining risk measures that can be used (building on these ideas from the previous paper) and then focusing on those that are the easiest to implement. So the paper will address principles that risk measures need to be based upon, especially the theoretical basis for risk measure correlation,

This group is composed of people from 10 different countries: Japan, Australia, France, Belgium, The Netherlands, England, the United States and Canada.

We want to be able to pull together a way of organizing some of the different types of legal, cultural and regulatory reasons that lead to different regulatory processes. Once you identify some types, you can fill the principles in that will work best in that arena.

We then want to be able to put together a case study for three different kinds of insurance operations—life, health and general. We also want to have a discussion on credit and market risk factors and the underwriting risk factors.

Then the real question—for those that like the mathematical challenges—is looking at the total company approach adjustments and how to assess the correlation and diversification benefits. And then we want to have a section on advanced approaches and also a discussion of operational risks.

### **Key Challenges**

One of the key challenges we face in this area of solvency and capital is that as actuaries and as accountants, because we live in accounting systems and frameworks, we tend to want to make sure we have an answer telling us our location: "I come up with my model and here is the number that I get today."

There's an increasing awareness—I think more in the regulatory arena than even perhaps in our profession—that maybe direction is more important than a specific location.

The old Heisenberg Uncertainty Principle says that I can either know exactly the position or the direction of an electron, but I can't know them both; and I have to accept there's this little fuzziness. If I'm going to set the little fuzziness on location, I can get a little bit of fuzziness about direction. But as I try to go toward one variable, I lose the ability to understand the other.

I think many might say that about our current reporting process. I can take the blue book, and I can say that every single number in that blue book is right, and I can spend my resources verifying and validating it, and I have no idea of the direction of the company. Certainly, if we say, "I just want to know direction," well, no, no, no—we need specific numbers and need to be able to tie back to them. But we need to be creating a framework that allows us both direction and location.

So this C-3 Phase 2 is I think, a nice project that allows us within the United States to move forward on this, and it's also something that's consistent with the kind of thought process and work that are emerging at the international level.

Even though for most of us, including myself, it's enough to just try to stay up with what's going on in this country, I think it's very important to understand what's going on internationally and know that it's all linked together—that the directions are similar, the driving forces are the same, and, as it turns out, the answers have interest in many places.

**MR. LONGLEY-COOK:** To round out our discussion, Dan Patterson is going to talk about the practical implications.

Dan comes to us from Alliance Life along with Dave. But Dan is currently responsible for variable annuity product development, concentrating on development of and managing equity guaranteed benefits; so he lives and breathes this stuff every day. Dan has more than 10 years of experience with background concentration in fixed, variable and equity-indexed annuities. He recently joined the C-3 efforts by participating in the task force and focusing particularly on model development.

**MR. DANIEL R. PATTERSON:** Today, I just want to walk everyone through some of the modeling issues we've confronted as we've been looking at some of these benefits. On the surface, everyone can run small models and, like Alastair just said, if all of a sudden the number is 1,000 or 10,000, maybe things start to get overwhelming, considering that embedded in any company might be 40 different fund choices with policyholders electing all kinds of mixes. So it's not just the old nice plain vanilla fixed annuity in which everybody's getting basically the same thing.

Today I'd just like to talk about four issues:

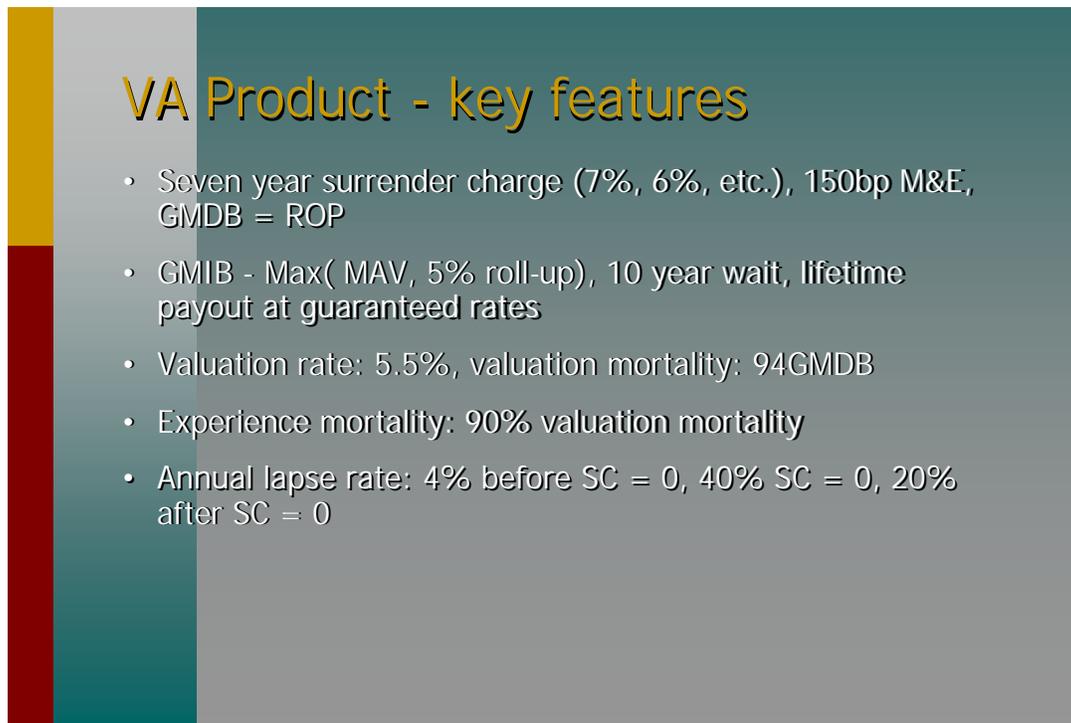
1. This may appear to be an unmanageable scenario-intensive process.
2. How do I generate these scenarios meeting these calibration points?
3. Do I have to run all 1,000 scenarios if that's the number to arrive at a good value?
4. How am I going to group in force, so that I am really, truly representing the real underlying risk that's embedded in the fund choices?

So my goal is just to illustrate some modeling techniques that I find greatly reduce time and effort but yet still follow the spirit of the proposed approach.

### **VA Product Features**

Just for an example in some of the numbers that I'm going to put together: I chose a plain vanilla VA with an income benefit rollup—it's a five percent roll up, but they'll also give you the maximum anniversary value (MAV), if that's greater. Make it a 10-year wait, and then take a lifetime payout at, say, 2.5 percent interest (Table 1).

Table 1



## VA Product - key features

- Seven year surrender charge (7%, 6%, etc.), 150bp M&E, GMDB = ROP
- GMIB - Max( MAV, 5% roll-up), 10 year wait, lifetime payout at guaranteed rates
- Valuation rate: 5.5%, valuation mortality: 94GMDB
- Experience mortality: 90% valuation mortality
- Annual lapse rate: 4% before SC = 0, 40% SC = 0, 20% after SC = 0

I chose the MAV in a five percent rollup, because that truly is a path-dependent option, and there, maybe you are really interested in scenario evaluation.

Lapse rate is going to be a pretty critical assumption, and so on this one I just said, "Well, how about we just go four percent before the surrender charge wears off, , 40 percent spike lapse and then 20 percent thereafter.

### Modeling Approach

So in the modeling approach, you identify issues that create unmanageable models. Can we find any key predictors that can reduce the need to do scenarios-on-scenario analysis?

Can we investigate any ways of finding out which of these RBC scenarios actually create negative surplus? You know, out of 1,000, there are going to be a lot where you make money. That present value is going to be zeroed out; so why run a scenario when you know very well it's just going to give you positive surplus?

Then use some grouping methods to group in force into a manageable number of cells. When I was doing this back in April and we had to get it in, Quad M was still on the table. And the RBC group was considering that interim reserves are going to be an important piece of that. Now, whether or not Quad M is dead, I still think there's a camp out there that's going to want some kind of an interim reserve calculated. So that interim reserve still may be a scenario-intensive process itself. I'm trying to

say, "Many times many is just way too many, so how can I figure out a way to eliminate too many?"

I guess this is just a picture for people who like pictures (Chart 1). I like graphs, but that's basically the picture. The red line is one scenario out of the 1,000, and then every quarter all those little black lines say, "OK, generate another 1,000 on each of those." So that's 1,000 times 1,000. Everybody gets the picture.

### **Approach to Reduce Scenario-intensive Calculations**

What's a way we can reduce the scenario-intensive calculations if we're going to have to do an interim reserve calculation? Well, we look at GMIBs as just embedded options. You take a risk-free rate, which is like Quad M. You could say it has some kind of volatility assumption.

In regard to time left to option expiration, we find that in-the-moneyness is a good predictor of the option's value, or what's called the Quad M value or the post reserve value. So I define this in-the-moneyness as the GMIB minus AB over GMIB. And I chose some end-of-year policy reserves, developed these additional reserves as a percent of, say, base CARVM reserves and fit a regression line to some of the data with my X variables being in-the-moneyness to try to get this curve for each policy year, and then get a regression function developed so that as I'm doing a one-scenario RBC, I don't need to do 1,000 to get an interim reserve. I develop some kind of a regression function that will get me close enough.

### **Factor Approach for MMMM Reserves**

So what I found graphically is the following (Chart 2): Each of these different colored dots represents a different particular policy year, and so generally they are not too far off. So for example, for a 40 percent in-the-moneyness, I would say I need 60 percent additional reserves on top of my base reserve. I think I was applying this to the base CARVM reserve.

This is just more of an illustration than real hard numbers; but generally what I'm finding is that these lines are very good predictors. You can fit a pretty good function—just A, B, C, X1 and X1 squared, where X1 is in-the-moneyness. We got real good regression. R squares and it felt like it was a real good thing to implement into a model.

### **Generating Scenarios**

Just some things about the scenario generators:

There have been a lot of questions about how to generate these scenarios and match all these calibration points. These calibration points are sort of a function of time, too: You have to match a set of calibration points one year out. You have to match one five years out, you have to match one 10 years out, and you have to keep them all together.

If you just take the lognormal generator, you're not going to be able to do it; it just doesn't come out.

There's been a lot of work. I know Al Zoglar has done a lot of work with trying to get this regime-switching process to fit the calibration points. I found that one way that I like is just to take the cumulative density function of future price returns and stratify it and say, "OK, if the calibration point at the 2.5 percent is a price return five years out of, say .98, then I know that if I generate 1,000 scenarios, I need 25, or I'm going to be under .98."

I just generate log-normals, and if I fill up a certain strata, I don't keep that scenario. I just keep generating until all my stratas are filled up. It fills up pretty quickly and looks like there are no dependence problems going from year to year; so it seems like a reasonable model and pretty quick to do; and it matches the calibration points nicely.

Another thing we're looking at is saying, "I'm not going to run all 1,000." It's a waste of time, so can I do a little bit of homework up front to identify which of those 1,000 are really the ones that are going to be the problem.

So we considered taking one single policy, projecting the top value and the GMIB along each of the 1,000 paths. You can do that pretty fast just on the one policy. We took the highest 200 that created the highest in-the-moneyness over the first 10 years. Then we said, "OK, we're only going to concentrate on those 200 and run them; and since we started with 1,000, we're going to get our 90 percent CTE on the average of the worst 100."

We're finding that approach gives as good an approximation as if we were just running the full 1,000.

Now, with an MAV, there's always the risk that you have a really great bull market, and then you have one year that really tanks. But we feel you're sort of replacing that one with a scenario that generated the value anyway, and the difference over the 100 isn't that great.

I just ran this on a living benefit product, and it's the greater of a ratchet or a rollup.

I'm seeing that just by looking at and getting this AV to GMIB and choosing the worst 200 that create the most in-the-moneyness. I'm taking 200. I'm really focusing on those, and then I'm taking the top 100 of those 200. But again, you want to do some testing on some smaller models to make sure that everything is holding together.

### **Grouping In Force**

I guess the RBC group has identified three fund groups—large-cap-type S&P, small-cap and the bond fund.

It's going to be the responsibility of the actuary to model funds into appropriate classes. Consider grouping all funds into the three categories, develop an in-force mapping and look at the key rates for these categories.

We were looking at having a cell. One would be a lot of the policyholders that are investing mostly in equities but are weighted more towards S&P-type funds than the more volatile funds that we have—you know, just going down the list and saying, "OK, here, I've got five groups, 16 quarters." Say I got 16 quarters of policy in force, I've got an 80-cell model, I guess that's not too bad.

I think it's important to investigate premodeling techniques to reduce the number of scenarios. Do some homework up front. Get yourself a nice model validated on some smaller models to say, "Hey, this is a better way to look at my total in force."

As Alastair has pointed out, actuaries are going to be responsible for documenting any short cuts to make sure that the value they come up with in the short cut is reasonable.

I also think regulators and auditors need some of these approximations to look at companies. Maybe a red flag has gone up—for example, I look at all of your in force, and on average your GMIB to your account value is a certain ratio. You get a feel for how much capital you should be having. And then if they see some red flags, they investigate more.

**MR. LONGLEY-COOK:** Some of you may be thinking, "Well, this is way off in the future, they haven't even figured out what it's going to look like yet; so I don't have to worry about it." Clearly, something like this is coming, so I think the smarter of us will be prepared for when it comes, even if you only use it for evaluating your own risk exposures, your capital needs, internal capital needs, and your pricing adequacy.

Is this a product you really should be selling? These techniques are what you need to do to figure that out, because unlike a lot of other guarantees, they only show up in these extreme instances—low frequency/high severity, as P&C actuaries would call it. Well, that's what we got here.

What we found in some of the modeling is that you get out in the tail, and things get really bad, really fast. That's something that we should all know as we sell these products today, not in 2003 perhaps when this regulation comes out.

As Dave said, international activities are going on. There are rating agency questions, Wall Street analysts' questions that are coming at us now, not in the future, that we need to answer.

So what I'd recommend is that you start preparing, gear up your models, get them efficient and use some of the techniques that Dan has talked about to simplify it. If you don't have models that do this, either build them or buy them, because whatever costs and expenses and resources you're applying to that now will pay great dividends if you can avoid the kinds of risk exposures and blow-ups in the future that some of these products do indeed look like they can produce.

As I said before, stay tuned. I think next week's NAIC meeting is going to be very interesting, as far as what gets said from the Academy's standpoint and the reaction from the NAIC standpoint. Some of that gets posted on their Web site, some of that perhaps gets communicated through some of the consulting firms or rating agency publications; so maybe that can help keep us all informed.

If you're coming to the Valuation Actuary Symposium this fall, I'm sure we'll have updates for you then as far as what's been going on in the meantime.

**FROM THE FLOOR:** My question has to do with GMIBs. Do you think there will be any guidance on other assumptions that need to be made, like utilization rates and that sort of thing?

**MR. LONGLEY-COOK:** That's a good question, and it speaks to the whole issue of how much guidance should be in the regulation and how much should be left to the actuary.

We are tending to take—in our recommendation, anyway—an approach in which we are passing the buck, so to speak, more to the actuary than these regulations have in the past. Whether or not the NAIC buys into that remains to be seen; but there is no way that we can put in a recommendation that then becomes a regulation and then gets promulgated—especially with all of the assumptions that the actuary would need to take, particularly with regard to policyholder behavior.

As you know, in CARVM, the regulators solved that problem by saying, "Well, you know if there's an option there, you assume the worst. You assume 100 percent utilization if it's an option, giving you this fairly conservative result that we've already talked about. And for that reserve calculation, maybe that's appropriate, maybe it's not, depending upon your outlook.

But when you're running all these scenarios and setting the standard at 90 percent CTE or whatever that comes out, that's where the conservatism is. So I think we would take the position that you don't need to double up on that by requiring a lot of conservatism or that kind of 100 percent utilization factor in that assumption.

I think we would recommend that the assumption be reasonable, based on experience to the extent possible, and justifiable. The problem is that there isn't any experience, right? I think all of us who have tried to price or do risk analysis evaluation of these products are faced with a problem that while we've been

through some difficult economic times, particularly lately. We really haven't been through a period where we have tested utilization and policyholder behavior.

If I had to guess, I would say that the regulation is going to leave a lot of that up to the actuary. Hopefully there will be standards of practice, or at least practice notes, as guidance. I'm sure there will be presentations and discussions at the Valuation Actuary Symposium in the future around this. But a lot of it will be up to the actuary to make reasonable assumptions around those factors.

**MR. SANDBERG:** I just want to add that Bob Brown's group is hoping to finish up this year so that by year end 2003, this would be available as an option for annual statement use.

Alastair's list at the end of the presentation said, "Areas that are still kind of open." There are some core approaches that we've agreed upon. We're just trying to work through some of the nuances.

Certainly if the actuary sets the assumptions at the risk-based capital level, then there should be required disclosure of any change in the future. There probably ought to be some report on analysis that's been done to verify or validate how your experience is playing out over time.

Again, the important thing to keep in mind is that we're not trying to find *the* right number at the end of the year. We have to make sure that over time, we're going to be getting to the right number. Then, as you get more and more data, you'll get better and better, and that's going to improve over time.

Canada found in 1990 when they went to a more company-specific valuation basis for both GAAP and STAT results that, they weren't ready, but they got there, to quote someone who went through it. It took them three or four years, but they feel really comfortable with it. Now, that's probably why they are a group that seems to be not so concerned about fair value changes. They've gone through a process of saying, "Oh, what does it mean to set assumptions and to track it?" Yes, it's a lot of work up front, but over time you start getting more comfortable with it.

**MR. LONGLEY-COOK:** If I could just follow up on that a little bit, think about the implications as far as responsibility of the actuary. You think, now of the valuation actuary or the appointed actuary signing off on the actuarial asset adequacy analysis.

Risk-based capital is a little different. First of all, you're not setting a reserve or a capital number necessarily; you're setting something that your capital is being compared to. And again the purpose of this is to weed out those companies that are inadequately capitalized. So maybe it has no impact on earnings or your current capital basis, except where you're getting close. And then, think about the RBC

actuary who is setting all these assumptions; and depending on where he or she sets those assumptions, that company may flip into company action level.

You can imagine, number one, the pressure that actuary might come under. Number two, what is the regulator going to do about it if one year they flip under? Are they required to take action with the company in that situation, where, in fact, maybe it's just a little statistical fluctuation?

I mean, these are some of the things that one can imagine and that I think the regulators also are thinking about, because in Canada, it isn't automatic. There is some back and forth and some play there, so if in fact some of these great formulas and approaches we come up with do produce some sort of volatility at one point, it doesn't necessarily mean that the company has to be taken over. So in some ways it's similar to what the valuation actuary is doing, and in some ways it's going to be quite different.

**MR SANDBERG:** Alastair, I want to just comment briefly, because I think an important thing to remember is that while there is some uncertainty about what may be happening at that level, it's also true that you have better information than you did before. I mean, if we were to say we're going to stay where we are today, you wouldn't know it was too late until it was too late.

**MR. LONGLEY-COOK:** Absolutely.

**MR. SANDBERG:** What we're really trying to worry about is when I should send in that early warning letter to the regulator saying, "You ought to look at us." Frankly, I think it gives a better tool for the actuary to discuss with management that this could be happening.

You know, I worry when we sometimes feel like we get to be the victim in this situation. It can be a great tool. When we look at economic results and pricing at our own company, our marketing group, our people look and say, "Oh, that's the reality of it; we'd better manage around it." Because nobody at the company really says, "We want to be selling a product that's really risky." By doing this, we're kind of highlighting information we have available to communicate the real stuff, as opposed to being a paid employee to find a way to get around a rule.

**MR. LONGLEY-COOK:** Yes, that's absolutely right, and the secret there—or the way to avoid the big blowup—is to do this early and often. In other words, if you wait until the last minute and run it and bang, you're under the threshold, then all hell breaks loose. But if you're running these analyses early and communicating with management early and saying, "Hmm, we might have a problem here," and you're doing that six months in advance or a year in advance, then you can work this out, and you don't get into the crunch.

So it becomes a management tool, not a regulatory requirement as we've seen

with some companies, Enron being one. There's always one way you can skirt around and take advantage of the system to do what you really want to do, but not the thing that you ought to be doing.

**MR. FRANKLIN CLAPPER:** I'm on the work group with these gentlemen, and I've been doing testing like Dan has. I appreciate the comments you're making, because the political process is at least as important as the technical issues we're dealing with.

I have a comment and a question. On the assumptions that you were talking about before, I've been testing GMDB more than GMIB, but it seems to me that when we combine the best estimate assumptions and the base projection with the CARVM reserves, we have a model inconsistency; and I think that's part of what's driving this problem. So that's where we have a lot more work to do, trying to figure out whether that model is internally consistent.

My question is really very simple. You said before that UL, I think, was excluded, but did anybody reconsider that when the new CSO table came out?

**MR. SANDBERG:** Not to my knowledge, and I think that's a good point. Basically the testing was really done, what, three years ago? And the analysis showed that profits overwhelmed the risks. I think you make a good point, Frank, that with the new CSO, will that still be true?

**MR. CLAPPER:** In other words, the results of the testing were based on the guarantees in the industry. And if the guarantees change, then you have to reconsider whether the profits still overwhelm the risks. That was the point I was trying to make.

**MR. SANDBERG:** Also, we have larger questions that we'll need to start dealing with. We have an isolated instance here where we can look at a C-3 risk in the annual statement and say, "Let's just look at that piece of it." But you're really bringing up is what are the C-2 margins? We don't really know. They may be exceptionally redundant, and they should be able to be used in other areas. Or they may be right where they're supposed to be. And that's kind of a next-generation question: How do we start pulling in margins from other risks and kind of getting a bigger picture put together?

**MR. CLAPPER:** Yes, and in this work we're doing, one thing that bothers me—I mean, I'm all for it and everything, but it's only part of the RBC; so it's going to be very difficult to keep this consistent with the existing framework. As we move forward, we're going to have to find ways to do that as well. I mean, we can't do the whole thing at once, which is a point that you mentioned, but we can't stay where we are, either, so somehow we have to take care of these transition problems.

**MR. SANDBERG:** Yes, and this should provide us a nice way to think through how we might approach it in other areas.

**MR. LONGLEY-COOK:** It is a constant challenge for these committees, and particularly the Life Capital Adequacy Subcommittee, Bob Brown's subgroup, to be pushing the envelope in terms of new standards for these new products and these new concerns by the NAIC, and yet have all this existing framework to drag along with us and say, "OK, is it consistent with that? Where do we need to update?"

All of the work, of course, is being done by volunteers who have real jobs, and sometimes their employers don't appreciate us spending as much time as we do on this work, as fun as it is. So part of our charge is to keep an eye on what's there, update it as appropriate. And it's a challenge.

**FROM THE FLOOR:** I just had a question about stability of results when you're doing a relatively small number of scenarios. What I've found in looking at out-of-the-money options or things that are similar to them, is that you need to do quite a lot to get a stable value for the outcome. I guess my question is, if you ran 1,000 and took the worst 100, and then you add another 1,000 and took the worst 100, you're going to get significant differences. Or it's quite plausible that you'll get significant differences when you're talking about things that are really rare events or relatively rare events. I guess I have a question for the people who have been doing this kind of modeling—what have they seen in that? That's going to need to be part of the practice guidelines: how many do you really need to run?

**MR. PATTERSON:** Because you're supposed to meet these calibration points, that eliminates a lot of that randomness just by running another set of 1,000, because there's this whole theory on quasi-random numbers that aren't random at all. So how do you fill up the sample space so that you have a nice uniform space fit?

It almost seems like it's not going all the way there, in theory, but I think it's doing that, because not only do you have to calibrate at your one, your five and your 10—although I can't say I've done a whole lot of testing on that—it seems like when I regenerate a different set of price returns, they're not that far off. I have to get 25 that are under this; I have to get another 25 that are under that percentile, etc.

**MR. LONGLEY COOK:** I'd like to add a couple of comments as well to Dan's response.

One is that we're not pricing options to the fourth decimal place here. We are trying to come up with as good an approximation as we can for this threshold. So I don't think the exactness is quite as important as it is if you were, say, pricing an option for sale on Wall Street. Which is not to say we should be lax and just say, "Hey, close enough, good enough." But it is a threshold that we hopefully are far above, and even when we get close, yes, something happens when you go over it.

But the fact that you are close is the key thing. So again, it doesn't have to be precise to the third decimal place.

The second comment is that we've talked about how much guidance to provide in the recommendation. Should we say, "Thou shalt do 1,000 scenarios?" No. We've hinted that that's the minimum, but it's going to be up to the actuary to do the kind of analysis that you're talking about: OK, do it twice and see how far off you are to see how robust it is.

A lot of the work that we did for Phase 1 indicated that when we just looked at the 50 scenarios out of 200, in fact it was fairly robust. And again, you don't come out with the exact answer every time, but you come reasonably close.

**MR. JIM REISKYTL:** I have a comment and a question. The comment is that I think RBC could be viewed as an impetus to doing what you ought to be doing anyway. I think we have to draw lines, and you talk about dragging along, call me The Anchor, because I think there's a real misunderstanding, and I'm trying to make the distinction.

I think we as actuaries should be doing risk analysis for our companies; if we're not, that's too bad your company isn't paying you to do that. You should be doing all this work anyway, and this C-3 RBC is just an excuse to do it.

But if you are selling products and you're selling benefits and you haven't done any kind of analysis, shame on you as an actuary. That's got nothing to do with dragging along. RBC is a tool to measure when you get taken over. The two are intertwined, because they both involve risk analysis.

You know, the dentist might not have a perfect mouth of teeth, but maybe all you want to do is eat. And the regulator wants to know where is this line, so forget about this drag-along stuff, I think. If you think there's pressure in picking assumptions for these supplemental benefits, imagine if you could drive your entire RBC by making up your own assumptions. I guarantee you no one will go broke until they are dead broke, and then you'll never be able to resurrect them.

So you start with a basic premise. Do you want to have a little breath in the patient before death, or you want to make sure it's absolutely dead when it dies? That may be an oxymoron, but I'm trying to make a basic point. I think actuaries aren't doing as much risk analysis, and I see too much evidence in which people have said they filed something, and the regulator says, "How did you get that answer?" A year and a half later they come back with a demonstration. One might wonder that the actuary ever did anything in the first place, other than produce what the marketers wanted.

So you can take that for what you want, but I want to make a distinction: I think we are grossly failing our companies and our users if we are not doing risk analysis

in everything that people have been doing. I'm part of this effort, and I applaud it all, because we're trying to understand it. It's interesting how we're trying to understand things, and people are already selling them. We're still trying to figure out how they really work. So that at least makes me pause.

That leads to my question. I just came from a workshop and I find both of them somewhat disturbing. And I ask people in this room, "How many of you get involved with your risk-based capital calculations? Two, three, four—maybe 20 percent of the people here. Larry Gorski reported this morning at our session that people are simply not doing it. I mean, they enter zeros .

And here we are saying we're going to take on greater responsibility when the stuff we're filing is garbage, in some cases. Now, I'm not dumping garbage on everybody's lawn, I'm just saying that it's very important.

**MR. LONGLEY-COOK:** Nobody here in this room.

**MR. JIM REISKYTL:** Right. This workshop was on financial reporting. I said, "Do you as financial reporting people believe that risk-based capital is part of your responsibility?" And they all kind of looked at me like "Is that part of financial reporting?" Well, I would suggest that it's in the statement, and hence it's part of financial reporting. You may have different opinions, but before we started getting all involved with very sophisticated things, I would surely encourage you and your companies, if you're not involved, at least take a look at it.

I just came out of that meeting. I frankly am very disappointed, but I wanted to raise it to the group and say before we take on these new responsibilities, let's be sure we're meeting the current ones. Larry suggested that maybe we should publish the whole thing if you want answers to your assumptions. So if you assume you have a guaranteed living benefit and one percent of the people will elect it, and Dave assumes 90, well, it will be in the public marketplace. And you can say, "Well, I can decide for myself if I like Dave's RBC or if I like your RBC." Now, you might both be right because of the characteristics and so on. But at least that's one answer.

The other thing he was talking about is creating a manual to review RBC. So as we look to the future, I'd at least hope we keep in mind that you ought to be doing good risk analysis. And let's not mix up RBC with good internal work.

**MR. LONGLEY-COOK:** Points very well taken, Jim. And we've all said here, I think, points congruent with that. And that is, don't treat this as a regulatory requirement that you're going to have to meet at some point, and you'll deal with it when you get there. Use a lot of this as ways to analyze the risk that your company is running, how you're pricing your products. Get involved, make sure that this is being handled right now, and use these techniques to help manage your companies better.

Chart 1

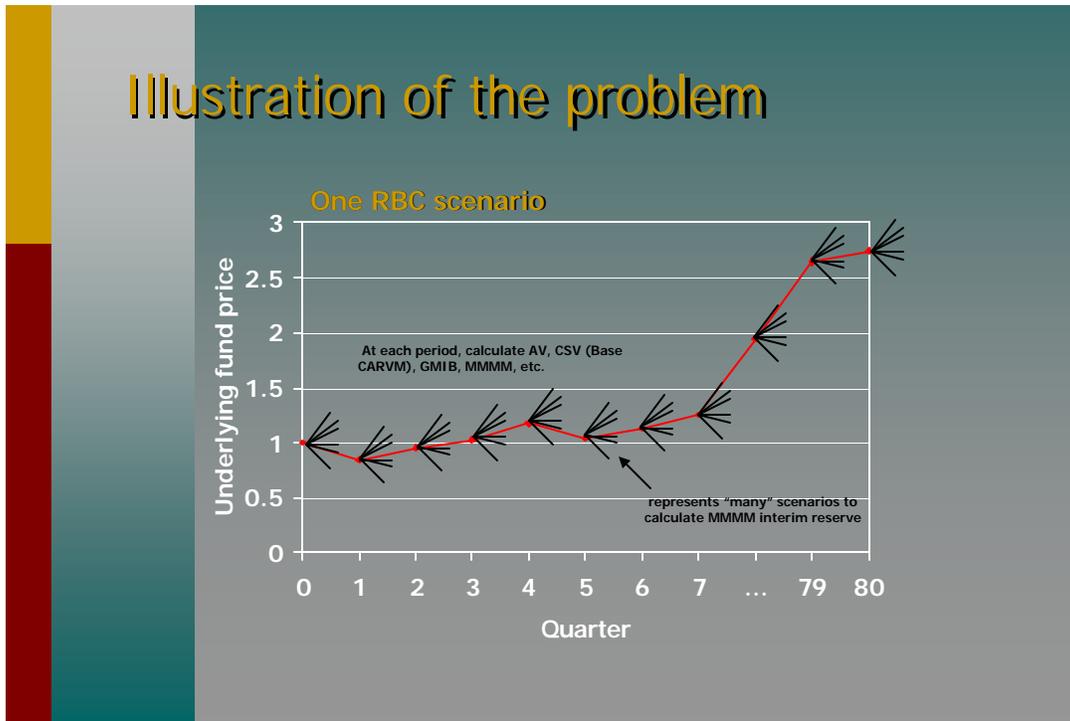


Chart 2

