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Catastrophic Risk in a Post-9/11 Environment

Track: Risk Management

Moderator: Joseph F. Kolodney

Panelists: Roger Smith
Jakob Kolbye
Tim Tetlow

Summary: There has been a heightened awareness of catastrophic risk since 9/11. The panelists discuss methods of assessing the risk, offer insight into how reinsurers evaluate it and discuss modeling and dynamic financial analysis tools that can assist in quantifying and evaluating risk versus reinsurance solutions.

MR. JOSEPH KOLODNEY: I'm the managing director of the life reinsurance practice for Aon Re Global Accident, Health and Life. We're going to talk about defining catastrophic risk in a life insurance portfolio, tracking aggregation of risk, modeling natural perils, terrorism risks, cost of capital considerations and evaluating functionality of reinsurance pricing.

We have an international panel, representing the United States, Bermuda, Continental Europe and Denmark. The panelists carry impressive resumes. The first presenter will be Roger Smith. Roger has worked in the accident and health reinsurance industry for more than 19 years. He started at the CT Bowring in London, which was ultimately acquired by Guy Carpenter. In 1996 he moved to Aon Re in Chicago, and since that time Roger has worked to build the North American accident and health reinsurance division. He has a tremendous amount of resources

Note: All handout materials are available through the link on the table of contents.

that can be helpful both to reinsurers and to ceding companies. He was educated at St. Andrews University in Scotland, and will be presenting first.

The second speaker comes to us from Copenhagen, Denmark. His name is Jakob Kolbye. He's a general manager for accident and health for Danish Re. Jakob has been in international accident, health and life reinsurance since 1980. He holds a Master's degree in Actuarial Science from the University of Copenhagen. From 1980 to 1991 he held various positions at GE Francona in Denmark, ultimately as appointed actuary. For the following nine years, Jakob was responsible for establishing and developing ReliaStar's International Reinsurance Operations. And in the year 2000, he joined Danish Re as general manager to boost the accident and health account. He serves on the board at Danish Re Syndicates Limited, and he will speak second.

The third speaker is a native of Bermuda. Tim Tetlow is an actuary working in an underwriting role, responsible for all people exposed catastrophe business, such as workers' comp, personal accident and life and multiline terrorist-specific business written at Axis Specialty. There he is senior vice-president and global actuary in charge of this business. Previously at Axis he was heavily involved in the building of pricing and accumulation tools, which allow a real time view of the airport portfolio risk profile. Before Axis he worked for St. Paul Re in London as a pricing actuary, and before that he worked on the reserving side. Axis Capital was the first company formed after 9/11, and it now has over $3 billion of capital publicly traded on the New York Stock Exchange and is rated A by both S&P and A.M. Best. They have operations and branch networks in Bermuda, the United States, Ireland, Switzerland and the United Kingdom.

MR. ROGER SMITH: We're going to be covering quite a range of topics. My first point is that all of us spend a lot of time talking about catastrophes and trying to help people with issues as they relate to catastrophes. One important thing to mention about them is that they are completely random, whether time, place, market share and corporate financials. A footnote I want to point out is that throughout our experiences we found one group life company that felt very comfortable with a 5 percent market share in the group life market. It had done some preliminary analysis of how that might affect them, but ended up having a share of everybody in the north tower of the World Trade Center (WTC) that was killed., which is good testament to their marketing, but exposed deficiencies on their risk-management side and how they looked at catastrophe potential.

Now I want to take you back a few years to the catastrophe market before 9/11. There was abundant capacity. A lot of it was fueled by life companies either directly or through the reinsurance pools that used to exist and provided a lot of well-priced catastrophe cover. The level of information that was needed was minor back in the days when the white-collar executive working in their office was considered a minimal risk. Of course 9/11 obviously disposed of that myth.

Relative to today or immediately after 9/11, the pricing was cheap. There were no exclusions, it essentially followed the form of the original policy whether it was life or AD&D. Reinsurers, for their part, did not monitor aggregates. If you wanted more capacity you simply had to ask. Any one particular buyer could quite efficiently purchase up to $600 million of catastrophe capacity at fairly normal expense for the higher $400 million. There was no modeling done, at least none that anybody has really confessed to. And a theme that I think will run through most of our conversations here is that there's really little or no consideration for the cost of capital certainly at the reinsurer level. That is obviously a big feature of what has been attempted after 9/11. The general philosophy there was it may never happen. But if I can buy a $100 million of catastrophe coverage for $10,000 perhaps that's a good idea.

Post 9/11, there is much less capacity and a lot of it is coming from different sources. At the risk of being unfair to Tim, I don't think you really dreamed about doing catastrophe life reinsurance. To the credit of those new entrants, a lot of them with property and casualty (P&C) discipline have worked diligently to try and catch up to the terminology of our business and the different risk dynamics and we'll have a look at that in a little while.

Detailed information requests are more common. The events of 9/11, of course, solved all the problems, because it was difficult to get a hold of that information. We knew that at the employer level information existed, but getting it out of the employer, whether the risk manager, risk management or HR, was always a challenge. Getting it from the broker was even more of a challenge. But that seems to have eased up, and we'll have a little bit of a discussion about where data can be acquired later.

It is more expensive. It went sharply up after 9/11, largely because 90 percent of the capacity exited the market. And there are exclusions, terrorism in particular. The two main perils that we'll focus on throughout this are terrorism and earthquakes. Terrorism is the most random and earthquakes affect a lot of lines of insurance. Reinsurers closely monitor their aggregates. That's a function of every reinsurer that exits, whether they're A&H or P&C. And as you'll see a little bit later on, certainly every P&C company is required to give detailed accounts of what their likely catastrophe exposures are. And that monitoring of aggregates also touches on cost of capital and why there is a cost attached to it.

Modeling capabilities have evolved dramatically. Again, I know that as a broker we had modeling capabilities for property before 9/11. I think on September 12 I actually started looking at life, personal accident, workers' comp and a lot of other things, just as everybody else did. And again, this notion of cost of capital is a driver. It's a key component of the cost of reinsurance. And it's a key consideration as to why you should buy reinsurance. The philosophy now, if you look at it from a reinsurer's perspective, will be that it happened, when will it happen next?

The perils that we consider when we're in discussions either with a reinsurer or client range from the least predictable, being terrorism down through earthquake and onto hurricane. It's interesting if you look at studies of catastrophic loss of life. Swiss Re just published something that said in 2003 alone there were 60,000 lives lost due to catastrophes in 2003. It was one of the worst years. In the United States we're not necessarily susceptible to things like tornado, volcano, mud slide and hurricane from a loss-of-life perspective. In part because of The Weather Channel and much more media awareness of when these things happen, although some of you may have read about the concerns around Hurricane Ivan when it looked as though it was heading toward New Orleans. Various agencies were predicting up to 50,000 deaths if that had hit the New Orleans basin, which would have been quite something.

Smith Slide 5 shows a depiction of some of the more costly in terms of life incidents that there have been. In the top left corner were catastrophes that were more recent and more close to home. As you proceed along the axis you get further away in terms of time and geography. Probably not quite so concerned about significant loss of life for today's audience. There have been some significant events outside of the United States. There have been earthquakes and mining disasters in China. In 2003 there were 41,000 people killed in an earthquake in Iran. But even closer to home are a few nightclub disasters, whether they be fires or stampedes. And as I said, the potential is there with something like Hurricane Ivan, which took a convenient right turn at the last minute.

From a modeling point of view, what kind of perils are we focused on? One of the more obvious is earthquake. There has been a lot of analysis in terms of loss of life, and on the property side, it's something of a science. They look at the soil types, building structures, etc Tornado is another prominent one. Smith Slide 7 shows you the analysis of where tornadoes happen: Generally around the Midwest and generally about 5:00 p.m.. If you know what your policy distribution is you can look at graphics like these by peril and figure out whether there's anything you really need to be concerned about. You can model manmade catastrophes also. Not terrorism, but the good old conventional catastrophes we use to think about, such as aviation disasters, for instance.

And then you have terrorism. There are two levels of modeling on terrorism. One is deterministic, which is just to say how many people you might have in a building if an event happens and what the damage might be from that event. The more esoteric, and where people are trying to evolve to, is a probabilistic study. Terrorism is probably the hardest thing to model because the incidence of terrorism certainly in the United States has been infrequent. Outside the United States there are a lot of data by country as to what terrorist groups are active, how they're active, what their usual attack means are and whether they're actually looking to take lives or just terrorize people. In the United States you have 9/11, which was a major act of horror and terrorism. You also had the first attempt on the World Trade

Center. Additionally, you have such incidences as Oklahoma City, which is internal terrorism. That is also obviously a consideration.

From the kind of analyses that we're used to performing, one of the more popular outcomes are some graphics of any particular company's distribution of risk relative to that peer group. You can do this with a number of data sources or comparisons, such as with the industry as a whole or relative to the working population, if you're focused on group life, or relative to the census if you're focused on individual life. Smith Slide 8 is relative to earthquakes and shows any given company's exposure and the demographics of those exposures relative to their industry group. Obviously, if a particular company had a lot of red bars at the far right side, that would mean that it had higher concentrations of exposures in more earthquake prone locations than its peer group.

People determine what reinsurance they should buy and will buy based on how they will look relative to their peer group in the event of a catastrophe. If something bad happens, certainly if you're publicly traded, and analysts find out your net loss, they might be very happy to hear that it is lower than your peer group's. They would be less happy if your net loss was higher than your peer group's and you didn't have a good explanation for it. So we've had some good feedback about this kind of analysis. And again, this is all very new, post-9/11.

So let me get back to the types of perils to consider. On the accidental man-made catastrophes, when we're modeling and we're trying to assess people's exposures, we're looking at the demographics within a particular client's book. We're looking at the industry group. Are they distressed? Are they focused in certain areas? We're trying to look at the at-work concentrations as well as at leisure. Leisure would be shopping malls, sports venues and areas where people congregate, where you couldn't necessarily glean those exposures just from looking at a group census. As I said right at the outset, I think people previously had looked at market share as an indication of likely catastrophic exposure. But the experience of that group life insurer in World Trade Center Tower One, and then the P&C industry as a whole shows that catastrophes are not particularly mindful of market share alone.

Outside of terrorism on the accidental man-made catastrophes side we have plane crashes, which are both private and commercial. A slightly shocking statistic is that there are on average 6.5 major aircraft crashes per year with an average death toll of 112. Ship wrecks also fit in this category, although more in New York and Eastern Europe. There are a considerable number of deaths in that type of accident. One that's close to where I call home is the Chicago River disaster of 1915, which had a death toll of 844. There are also industrial accidents, such as the 3,849 deaths in a chemical plant in Bhopal, India. There are also fires, such as the 100 deaths in a night club in Warwick, R.I. in 2003, as well as other instances, such as crowd stampedes..

The challenges with terrorism are how do you model it and how do you assess what you expose yourself to? Nobody really knows where future terrorist attacks might occur or what form they'll take. In discussions with my panel colleagues and others the question of are we really afraid of a nuclear event comes up. Is it realistic? How easy is it to achieve? Why haven't there been suicide bombings in the United States? Just how do we approach it? What can we do? We've got no idea how likely they are or how frequent they'll be. What's the insured loss under each scenario? What do we do from a modeling point of view? We start with as many facts as we can gather, and then pile some assumptions that are as educated as possible on top of that. We do that in conjunction with our clients. If it's a scientific process on the property/ casualty side, it's a healthy blend of art and science on the life and the accident side. It requires a certain matter of interaction. So what anybody that's done any modeling has done is develop a database of potential targets. That can be a little bit subjective, but there are a lot of informed sources, such as the Federal Emergency Management Agency (FEMA) and certain government Web sites, which provide you a lot of information on where there may be targets. And this information shows that these are the highest buildings in each city, political areas, state capitols, sports venues, shopping malls, prisons, key route bridges and the like.

You can put some probabilities together in terms of what's the likely attack. We know it's a lot easier to park a medium sized truck outside a building than it is to put together a nuclear device. So you can assess certain probabilities from that point of view and then develop a range of annual frequencies. Are we looking at one in every five years, or are we looking at five a year? Should we look at all of those?

And then we give each attack some kind of damage probability. That, surprisingly, is not a new science. I think a company started doing this shortly after World War II at the behest of the U.S. government. And it eventually got a significant amount of information as to the damage in terms of loss of life, in terms of injury and a radius for a number of different kinds of events.

So if you're building a terrorism model you start with your hazard. Then you look at what the location of the attack will be. Are you looking at a sports stadium? Or are you looking at a corporate headquarters? Then you look at the type of attack, which could be a truck bomb, plane crash or basically anything you choose. And then with that you build up your event simulation. One particular model contains, I think, close to 20 different kinds of attack with 5,000 targets. So you can get a simulated 100,000 events.

Then you look at your vulnerability. If one of those events happens, what are the consequences of the building coming down? How many people will be killed in it or maybe killed by the blast? Will they be killed by flying glass? If you look at the attempts to disperse chemical agents, they've been in Japan. They've tried and there's been success, but on the grand scheme they've actually been failures from a

terrorism point of view, because they were agents that have been very difficult to disperse effectively. So you build up your patterns for each attack.

And the last component is developing insured loss. That's where you look more at your policy's specifics. Paying face value of the policy, are there any riders? Do you have any coinsurance? Do you have any pooled reinsurance arrangements? Those three components will get you to some form of modeling capabilities.

There are several terrorism information requirements that A.M. Best imposes on property/casualty companies. As yet this is not required of the life industry, but depending on whom you speak to it may be in the future. It's probably something that's worth thinking about to be preemptive.

The requested exposure information includes the following:
• The five largest single insured locations, as measured by total gross losses (limits) from property (building, contents and business interruption) and workers' compensation exposure.
• The five largest single insured locations considered targets at risk for terrorist attack, as measured by total gross losses (limits) from property (building, contents and business interruption) and workers' compensation exposure.
• The five largest "zonal aggregate exposures," as measured by maximum modeled occurrence loss using user-defined geocoded areas, loss scenarios and loss distributions.
All of the exposure information is required gross, net of private reinsurance and net of private reinsurance and TRIA.

So the point here is that the rating agencies have caught on and gone to the modeling that is being done on the property/casualty side. They are now requiring people to divulge that information. Who knows what they will do relative to the life industry?

Compiling data to get our model up and working was certainly the challenge immediately post-9/11, but it has lessened a little bit now. Ideally you want to secure the net retained sums insured by location. And in the United States that's best looked at on a zip code basis. Individual life companies typically have billing addresses of individuals that yield the residential information, which helps you with your five to nine exposures, but not so much with your nine to five. And on group life, to varying extents we've had people successful in gathering data about where the work force is and what exposed values they have there.

Another area to look at is the U.S. census. I don't think anybody believed when they filled that out exactly how useful that would be in this exercise. But on the individual life side, for instance, if you know where people live, the census gives you a lot of indication as to several things, such as what means of transport they take to work; how far they travel to work; and what kind of industries they're in, based on the county that they live in. And you can start to compile some meaningful analysis

from where those people reside and where they might work, and draw some conclusions about what kind of concentrations exist there.

There are also some external databases. Dun and Bradstreet is one in particular. On a fee basis it will provide reasonably accurate information about how many employees are in each office. And if you're looking at a corporate tree, for instance, it will show you where all the subsidiaries' companies are, where the branch offices are and how many people there are in each. So between internal client data and external third party data you can actually build up a pretty good picture of where your exposures might be.

Now let's look at what kind of outputs you get from this model that you're building. Summary exposure maps are one thing. You saw the tornado map. You can do some fairly detailed mapping on a nationwide level, state level or even a city level where exposures crop up. Sometimes it's easier to look at this pictorially.

Another thing you get is a terrorism relativity analysis for major target types. I think most of the people that are doing some modeling use the key proxy for rescues as distance. So if you say we think this is a target, let's look at how many millions of exposed values we have within an eighth of a mile, quarter of a mile, half a mile, and so on. If you look at 9/11, I think it was 98 percent of the loss from a life perspective occurred within a quarter of a mile of the two towers. If you're looking at, say, a disability portfolio where you're focusing more on injury, obviously that rate is expanded significantly.

As far as other outcomes are concerned, you can look at your largest exposure on a concentration basis. So, if you wanted to look at New York, you would look at how many people you have in New York and what exposures you have there. Or, you can look at it from a target point of view. How many values do I have within half a mile of the capitol in Washington, D.C.? You can get some fairly detailed maps of hot spots.

The probable maximum loss analysis is more of a P&C term, but it's something that I think has entered into the language of a lot of people that we talk with. So you can show us the worst-case scenario, but really what's likely to happen? This is more of an assumption than anything else. Getting back to those frequencies I talked about, whether it's one in five years or five in one year, you can develop some probabilities, which will help tell you what your likely average annual loss is and look at different weapon types. If you're looking at coverage that either includes or excludes terrorism, maybe the modeling helps you decide whether you should have it included or whether, because you've got particularly rural exposures, you're not so concerned about some of the worst kind of attacks.

Smith Slide18 is a very simplistic sample slide based on modeling outcomes. It's based on the amalgamation of certain companies that have been modeled. It shows you that California, New York and Texas, as you would expect, have fairly high

amounts of net retained exposure. And pardon me if my geography is not right, but a couple of those states up in the northwest don't have a lot of penetration. But there's not a lot else up there and not a lot of risk.

Smith Slide 19 shows another outcome. Ground zero in a dictionary is described as the epicenter of a nuclear event. All this shows on a given portfolio is, looking at various major cities, how any company's exposure increases the further you move away from a target at the center of each of those cities. You see that this particular company actually has somewhere around $50 million of exposure close to the heart of New York City, but very little within a mile of the city center of Washington. Again, depending on the demographics within your portfolio, if you have a lot people that you feel commute further into the city, this is an indication of what your worst-case scenario will be.

Smith Slide 20 is actually Chicago, based on the Sears Tower being the epicenter. It shows out to a mile. A modest nuclear bomb would have fairly significant impact out to a mile, in terms of its impact on human lives. And you can see all the little pictures in there on other generally accepted targets. So that's fairly chilling. There is a Web site you can go to where you plug in your zip code, select your preferred nuclear device, whether it's a 100 megaton bomb or whatever, and then it will quite calmly run off all the damage that will occur and out to what radius with some reasonable descriptions of what happens to the human body.

They also have some very interesting Jpeg files on that, which go back to the '50s in American nuclear testing. One of my favorites is a handful of soldiers that are off in a trench with their binoculars up watching the blast that's going to occur in the distance. The blast occurs and five seconds later they are all knocked off their feet. Clearly they weren't standing quite far back enough. It's scary to see the impact of these things.

As a buyer, what are my choices with all that stuff? Well, you can do nothing. And stick to that it-may-never-happen philosophy. There are some reinsurance pools that you can look at. There is catastrophe reinsurance, and there are some alternative structures, although not many have been done. And what are the consequences of any of these particular choices. I've started with the alternative structures, because not many of these have been done. Smith Slide 23 shows an overview of where those play. Typically if you're looking to transfer a high economic volatility, which is certainly what a nuclear catastrophe would be, there's a high cost associated with that. And typically that's best suited to the traditional market. The lower the economic volatility you want to transfer, the lower the cost you're looking at. And that's where some of these alternative structures are more smoothing mechanisms, if that's not now a dirty word, come into play. If you're talking about a nuclear catastrophe it is challenging to model and it is challenging to demonstrate to a reinsurer that it really will only happen once every 26.8 years. So this is the technical rate you need to charge.

Now I want to discuss the reinsurance pool. At the risk of offending anybody it's worth remembering that it is pooling, it's not risk transfer. If you're a member of a pool you share in the misfortunes of other members of the pool and they share in your misfortunes, as opposed to risk transfer, in which you pay a premium and the people you pay a premium to share in your misfortunes exclusively and don't hand anything back. It's effective for isolated catastrophes. Certainly if you're looking at something on a very regional basis and you feel as though your exposures are very remote, then it's effective. A key question I think you might want to ask is who are the other constituents? If you're a one-state, or a few-state life company and you're in there with one of the behemoths, then what's the probability of you sharing in their loss relative to them sharing in your loss? It's a question that's worth asking.

And what is the risk of the assessment that you run from a pool exceeding what you might recover? There are stories about people that got a bigger assessment than they were able to make recovery. There are also other issues that you want to ask questions about. What is the aggregate recoverable limit? If there is truly a big event that affects everybody in the pool, is there a cap to how much can be recovered? And obviously, is it cheaper or better than my alternatives?

Now I will talk a little about the cost of reinsurance capital. There are two aspects to this. One is at the reinsurer level, which Tim will talk about. The other is at a buyer level. One of the important considerations for you in evaluating whether reinsurance is worthwhile is what the cost of that is relative to my own cost of capital. If I have a catastrophe, what impact does it have on my balance sheet relative to the cost of off loading it on to somebody else's?

Catastrophe reinsurance is a choice. Risk transfer is fairly clear-cut. It's basically a simple transaction. It can be made complicated. A question you have to ask is will it pay? Are you buying from the right people? How do I evaluate the cost and the benefit of it? It's difficult. How much do I buy? Maybe that's driven by the modeling that you do. Maybe you have to be driven, to an extent, by the rating agencies. What retention should I keep? Again, modeling can be of some help there. Ultimately it is a known quantity.

Smith Slide 28 is a graph that demonstrates very generally some of the components of catastrophe pricing and how they vary as you increase retention. There is a certain logic to saying, if I retain more it should get cheaper. But that's not necessarily true because of this large area at the bottom being cost of capital. You want a reinsurer that will be there to pay your claims. They will only take on a limited amount of business. Therefore, there's a charge for that amount of business that they'll put on to guarantee that they'll be there to pay it. The little triangle sliver at the top is the traditional kind of perils we use to think about, such as aviation, etc. Once you get to a certain retention level it's difficult to generalize for the audience. But there are very few companies that are going to look at having an aviation peril greater than $20 million to them. And then obviously, you put

terrorism and quake into the mix.

My last topic, which will lead into what Jakob is going to educate us all on, is what has happened to reinsurance pricing post-9/11? Traditional risk transfer has sharply increased, but thanks to a lot of hard work on behalf of our associates, there's now a lot of fine tuning on the writing. Take into account whether you're looking at group or individual exposures, and the demographics of the book. Is it rural versus metropolitan? Are you looking at single locations? Are you looking at the whole book? There are different levels of terrorism coverage, different retention levels, limits of cover sought and loss experience. So all of these things are taken into account. And it's a little bit more user friendly then it used to be.

MR. JAKOB KOLBYE: My angle to this will be the reinsurer's point of view; it will be anecdotal presentation not technical. I've been in this business for almost 25 years, and throughout the 25 years I have played with catastrophe reinsurance. It has been a fun business for me to operate in and it has sent me around the world. I've met a lot of people, done a lot of business and had some fantastic results. The downside of being involved in this kind of business is that when the claims happen they are very, very severe. I have personally been involved in managing and adjudicating claims with family tragedies, criminal violence, bus and train accidents, building fires, mining disasters, flight crashes, ferry disasters, earthquakes and the terrorist attack on 9/11.

I've been involved in a lot of areas, going from a family of four drowning in a car accident out in Korea a month ago, through to what we would characterize as the traditional disaster of the air crashes, and going into 9/11, where I, for instance, was involved in looking at more than 500 death certificates. That's no fun at all.

What are we scared of when it comes to catastrophes? Well, certainly the biological-chemical terrorism, which we yet have to experience. Another one I have not yet experienced is the tidal wave issue following an earthquake. Some people refer to the situation as the New York scenario, where you have a major quake off the Canary Islands that could result in a tidal wave crossing the Atlantic in seven hours. That would mean a speed of more than 500 miles per hour. How realistic is that? You don't want to be around when it happens, because the anticipated height of the tidal wave would be 70 feet. Of course, in reality it will reduce dramatically, but you want to be away.

Think of this. Some 44 years ago something happened in the United States. I found it on the Internet. I don't know too much about it. But out of curiosity I was looking around. On July 7, 1958, out in Alaska, there was a 1,700-feet-high tidal wave. Fortunately, it was confined to a small bay area. It hit nature big time, but there were only a couple of casualties. Realistic or not, those that worked with a claim for the New York scenario, had a several-thousand-year return period. So there's a pretty good chance that none of us are going to be around if and when it ever happens.

On today's subject, which is really post-9/11, all of our experiences relate back to pre-9/11, and for the sake of argument look at what the marketplace was like then. We had different rules then and we have different rules now. There were a number of players offering left, right and center. There was up to $100 million catastrophe coverage to life and, of course, accident portfolios. There's a slight disagreement in our numbers here because I stated that there were more than a billion capacities available out there and a huge cover could be placed in just a number of days. The aggregate monitoring hardly existed. I know of a few people that did actually monitor the maximum downside. One company in the mid '90s had written probably more than $400 million of exposure in Japan. And I knew we had limited reinsurance protection. I called my bosses and said, "What on earth are we going to do about this?" And I was simply asked not to kill the goose that lays the golden egg. As a marketing salesman, I did what I had to do. Speaking about the reinsurers, none of us really wanted to touch this issue. Because if we started to get into it, those who fed us business would just go elsewhere. They wouldn't want to entertain that burden of providing us information, because the rest of them didn't require it.

Offering these large capacities was based on gearing. Our reinsurers would provide us capacity that allowed us to provide $50 million. At Danish Re for instance, in 2001 we had a capacity of $45 million, to offer to our clients. Behind that we had protection of $44.5 million, excess of $500,000, which in a way means we had a net retention of $500,000. We paid $800,000 for that capacity of $44.5 million, and we thought that was expensive at the time. Prices were dirt-cheap. One problem in addition to market function supply and demand driving the prices down was that very few used a technical model to price the business. Many developed prices. Now what is developing a price? That is to take your prospect and look at something similar you might have in your portfolio. You sit down with your peers and you go through it, comparing to see whether you like it or not. And then you probably bind the case. My question there was how did you ever get to bind the first case?

As Roger mentioned, cost of capital was not an issue. We will get back to that. And we also disagree on the prices for extra capacity. But I'll meet half-way and say $50,000 for the last $100 million, a rate online of .05 percent. That was not a board decision at the time. It was something the reinsurance manager just did and got on with the business. We offered these capacities in the '90s left, right and center. Roger mentioned the company that had almost every life in Tower One. There was no control over that. I as an insurer would probably reinsure my fellow insurer who wrote the same risk as I. One step behind, I as a reinsurer would reinsure those insurers and probably those other reinsurers. You can see how it builds it up, creating the pool issue, which I'll not dig into. It made aggregate monitoring completely impossible. No wonder we didn't want to dig in.

Then came the day, which I won't touch on in itself, but the immediate effect for the reinsurance market was that capacity spread. One company had total losses of half a billion. They had too little reinsurance protection, so they had a net loss of

$500 million. What you do then is drop the catastrophe line of business immediately. And numerous others did. I can understand that from an emotional point of view. Looking back now, for those companies that might not have been the soundest of decisions because of the changes in prices. When you burn your fingers this big once, it takes a very courageous person to decide to carry on with the business at the new price level with the risk of having to go back to your board and report bad news once again in the future.

After 9/11 everybody knew that prices had to change because the market structure had collapsed. But in the early days only those who had a technical approach to pricing had come up with the first prices. However, that changed soon into 2002. Our price went up by a factor of four to five going into 2002. We are just about at that level even today. That's a dramatic price increase, and of course, short-term terrorism was uncoverable. Then we get into 2002, when capacity became available. Bermuda initially did not touch on this business, but I would say during 2002 it started looking at this business and came in filling up the gap. A traditional reinsurer, which I would not classify the Bermudians as, now no longer would go anywhere near the $50 million to $100 million protection. We would offer $5 to $15 million with strong limitations in our terms and conditions. This thing called reinstatement, in which you maintain your cover after your loss, you would have unlimited and free in the old days. That's gone. Now there are strong limitations on one to two reinstatements and you have to build an automatic payment for it. We, as reinsurers, differentiate where we operate. In the old days we would give everything to everybody, almost. Today, some of us would look forward to larger clients where the larger premiums are. We, being a small reinsurer, would look for small- to medium-sized clients, and the same goes for terrorism. Some go full blown and have that capability. We, again as a small reinsurer, have our limitations there.

And the cheap retrocession that allowed us to gear our capacity is totally gone. The name of the game today is exposure management—and we all do that. Our board requires it, our owners require it, and our commissioners and financial supervisors require it. We cannot get by. And we as sellers we do both the manmade and the natural disasters.

Now I'm going to discuss pricing. Not everybody in the reinsurance market in today has a technical approach to pricing. The subjective there might be more healthy today to be addressing it that way because of the current price level. I know of several players that have entered the market that can model big time, but who have directly said to me, "We don't know how to price this business. So our belief is that the prices are good enough." That scares me a little bit, but that's a fact of life. On the other hand, if nobody dared to do that, we wouldn't have sufficient capacity in the market. I wish that actuaries around the world continued their efforts to refine and further develop pricing models for catastrophe business in the personal end area.

Being involved both prior to 9/11 and subsequently we've done a rate on line profile for our business, as can be seen in Kolbye Slide 9. For the layers we write and have written these four years, you'll see the bar to the left, where almost 50 percent of our catastrophe business at that time had a rate of line of less than 0.25 percent. Rate of line is the premium for the layer divided by the stretch of the layer. The 100,000 over the 100 million.

Seventy-five percent of the business then was at rate of lines of less than 1 percent. There was no money in this in those days. And actually we still made money until 9/11 because there were people behind us offering us even cheaper protections. You see the move immediately into 2002, the below 25 percent almost disappeared and I'm actually a little bit ashamed that they did not disappear totally. It's not an error. I know where it is, it shouldn't be there. But there are no names.

Today our average rate of line for this niche line of business in my book, which is for small- to medium-sized companies' catastrophe business is around 2 to 2.5 percent. An interesting effect you'll also see in the two right-hand columns, the second bar from the right is the highest in both the 2 to 5 percent, and in excess of 5 percent categories, that's the 2003 rate of lines. They have come down for 2004, and those of you that buy the type of reinsurance certainly know that there would have been a minor market adjustment. I think the market can easily take that. But I'm also convinced we will never get back to the pre-9/11 prices. I'll try to demonstrate why through the simple cost of capital consideration in Kolbye Slide 10.

We are multi-line player, meaning that in addition to life and PA, we write property on the cover of the lines of business. With that split of business we have a risk-based capital requirement of 100 percent, meaning that our owners have to put up capital of 100 percent of premiums to support our ratings. This is an example, not the exact reflection of reality. We assume we have 10 percent administration costs, 2 percent levies to the Lloyds organization to operate in that market, and 10 percent brokerage deductions. We have owners who are even more greedy and they would like to have a 20 percent return on equity, as an example, on the capital they put up. So that's 42 percent, leaving 58 percent to pay for losses in this example. Now we would not want to have an average of 58 percent, because then we're too exposed when we're above average. It is not unrealistic to assume that the average loss ratio for this could be in the vicinity of 25 percent. Note that figure, 25 percent is the expected losses.

Prices before 9/11 were 20 percent of what they are today. So with the cost of capital consideration where we have expected losses of 25 percent, and premiums in the old days of 20, there was something that did not match. That's probably one of the reasons we didn't do cost of capital considerations at the time. There was no way we could make them add up. And of course, the cheap retrocession went. Prices have changed to what I believe is a more realistic level. And the question is a question we reinsurers are being confronted with very often. The question is why

are current prices so unreasonably high? And my statement to you is the question is wrong. I've tried to make my point. Prices then were ridiculously low, prices today are maybe not exactly where they should be, but are much more realistic. And if we have to operate with cost of capital approaches there is no we can get back to the past. So we together have to find a way to live in current reality.

MR. TIM TETLOW: From a catastrophe life area, there are various threats , each having an associated frequency-severity relationship. Some examples are earthquakes, terrorism, airplane crashes, industrial accidents or fires, tornadoes, natural biological epidemic, war, asteroids, tsunamis, heat waves, etc. Some of those affect life a little bit more than or less than property, for example. People tend to know about hurricanes, for example, and move. So what you need to think about really depends on what you're looking at. What we're trying to do when we're looking at the aggregation of risk is to determine what we have where and how much it's worth. One of the key concerns we have is the data quality that we actually receive. The property catastrophe world has looked at property exposure since Hurricane Andrew and had a lot of time to look at exposure and build tools to assess what that exposure is. So we get very specific information about the exposures we've had there. The challenge that has occurred since 9/11 really is what happens on the life side. Jakob talked about being a player prior to 9/11, but as somebody who didn't really look at this business prior to 9/11, the information about exposures was not really there. After 9/11 in the workers' comp line of business, which is also people exposed CAT business, we've seen a tremendous effort for people to understand where their exposures are on the life and PA side. We see much less ability. So what we're really showing there is what we see as sort of the typical data that we're getting nowadays between the property workers' comp and life PA books of business. There are different coverage effects that one needs to think about for those different risks.

When we're looking at life exposures specifically, we have a number of issues we need think about just from a modeling perspective. We have to address issues such as looking at individual life book of business. When people tell us where those exposures are, what are they really telling us? I think they're telling us where their residential postal address is, and similarly for group life they're telling us where they work at nighttime. Life insurance policies are in effect throughout the day, so we really need to think about how we get people to where they are for the events we think might affect them. For terrorism, for example, we figure it's mostly a nine to five type peril and so therefore, we need to move the individuals to their place of work and there are some statistics that allow us to do that.

Another thing that we need to think about is how we deal with the data resolution issue. If we have information on the business that really just tells us it's in New York. Well, we're thinking about the size of a 9/11 type of attack. How do we resolve those issues? And the approach we've taken is to try to move the people toward where we think the most likely events might be. And we do that is because

we need to make sure that we are going to be able to be here to pay for your claims, and that's the only way that we really feel we can do that.

Another issue that we also see lies with differing levels of information. Occasionally we find an issue around what people tell us about the value of their portfolio. You'll always have an idea of what kind of data you have in your organization, but we received one submission and when we started burrowing down to get to the best data we could find, we found that the New York face values on the policies were three times the average of the nationwide exposures. And that was what we started off with. We started off with a nationwide average. So that meant that really we had much more exposure in New York. It intuitively makes sense that you might find there are more investment bankers in Manhattan. And that's another issue. If you're really only looking at these statewide averages, you have a face value profile. You really need to think about getting at a finer level of resolution of data to be able to understand what your true exposures are.

And when we looked at the pricing that came out on the contract,. it made perfect sense. If you had looked at the nationwide average face value, the contract would make sense from a pricing perspective. But when we looked at the fact that in New York there is some terrorism risk and this contract had terror in it, it didn't make sense because there were accumulations that were large enough to be relatively frequently attaching a layer. And therefore, it needed more price.

We try to accumulate on a daily basis across our insurance and reinsurance areas for all of our risks. This is not just for the people exposed risks, such as the hurricane risk or tornado risk, but for all our risks. We do that because we really need to be at a point today of knowing what we can take on. We have risk coming in all the time. There are some things we needed to build in there. We needed to handle how we deal with the fact that honest people expose business. If it's life business, we might not know where the people are as well as we would for workers' comp. And with property, again, the data resolution is not much better.

We wanted to consider the accumulation consistently, and one of the issues that I think occurred pre-9/11 was people thought how we can sell this stuff. They thought it was never going to accumulate with anything and we were never going to have a loss. We thought we wouldn't have the issue of a big property loss, a big life loss and a big workers' comp loss all at the same time. I think you know the World Trade Center makes it clear that that isn't the case. We really need to think of everything together. One of my first roles at Axis was to help in the building of those systems.

On the earthquake side it's fairly established that, you can look at the seismic activity within a region and apply some rough methodology to allow you to assess how often you think, for example, the San Andreas Fault might break.. So that allows us to build these models, which have 10,000 years of possible years for next year. And your 10,000-year scenario says you have probably the most extreme

earthquake and you might also have a big hurricane, but these are stochastically generated event sets, which represent what might happen over the next year for 10,000 possible cases of next year. That gives us the ability to price the business because these are possible outcomes for the next year. We need to think about those in a probabilistic way. So we're able to look at the size of loss, as well as the relative frequency of loss.

Tetlow Slide 1, Page 4 illustrates the issue associated with frequency in terrorism as I see it. I'm a real non-believer in the ability to determine what the frequency of the next terrorism is going to be. Is it going to be one event next year? Is it going to be three events? Is it going to be one event in 10 years? Or one again in 50 years? I don't know the answer.

There are three models that have really sat there from the property catastrophe side of things to look at the natural perils risks. They are AIR, RMS and EQECAT. Two of them got involved with a study that Towers Perrin put together to try and look at the ability of the workers comp industry to put a pool together. This graph shows the relative risk, or the relative expected loss between those two models. Now if you put a bomb outside a building each model will give a relatively reasonable severity estimate of that loss. The difference between these two lines is effectively the relative frequency pick. It works out to be about 4.5 times its difference between those two models. It's rough anecdotal information that is not exactly correct, but to me there's a lot of uncertainty with the frequency.

So the way we actually go about looking at the terrorism risk from that perspective is to flip the problem around. Really what we want to look at are the accumulations that we can possibly have within certain size circles. We look at these circles in the same way that we look at the natural perils. For the terrorism peril we look at various size circles in order to give us a view of the possible losses that we might have. Now obviously the contracts coming to the market have various terrorism flavors, as I like to call them. There are conventional bombs, which would include things like, the aircraft attack on the World Trade Center, and then you get into nuclear, chemical, biological and radiological exposures. And typically people will buy their terrorism coverage segregated between those two types of terrorism.

There's a second category, which doesn't quite affect the life market at this point. But there's a federal solution put out in 2002 called, TRIA, which sort of removes Al Qaeda-type events or gives some relief to the property catastrophe insurer's for those types of events. Life at the moment is not covered by that, and there are some discussions in the renewal for TRIA that are going on at the moment as to where the group life might be included.

So when we're doing this accumulation process, we need to think about the fact that not all of our policies might need accumulation from the total state and contiguous state basis for nuclear, because they don't have nuclear exposure. A five-kiloton nuclear device has a 27.3 kilometer radius of loss potential, so it's

pretty big. That's why we look at total states. It's also addressing the fact that from our perspective the data we get, particularly on the life and PA side, is not in a detailed enough manner for us to make any better assumption about where it is. Therefore, to be conservative we have to look at a state level of accumulation.

I spend a lot of time looking at the models and trying to understand how they estimate severity. I reckon they have a reasonably good ability to do that. As I said, the frequency estimate is a complete guess. But we have made a guess and put a line in the sand, which allows us to literally provide a benchmark that we apply to all of our contracts as to what we think the frequency is. It's a guess.

We have to deal with this issue. We take the statewide exposures and consider that in relation to the event resolution. If we have something that only affects the zip code and we have a state worth of exposure, how do we handle that?

These are just some of the events from one of the modeling companies. For a five-kiloton nuclear bomb they estimate a loss of 500,000 people. For a 74 kilogram anthrax attack, the loss is expected to be 173,000. For a conventional 10-ton bomb, they estimated 12,500 lives lost. For a 1,000 kilogram sarin chemical attack, they predicted 6,800 losses. For an earthquake, particularly in California, they expect maybe 20,000 people may die. You spend a lot of time burrowing into these models, and all models will have some issues associated with them.

The point here is that if we have the potential to have this desperate number of people dying in events, we really need to think about modeling these perils, accumulating these perils and charging for the capital on these perils individually. We can't just take the simple approach of choosing arbitrarily for conventional bombs and double that number of nuclear weapons.. It really varies depending upon the size of the event that you might have.

Another thing that we do to understand the risks that we have on the books is to look at something called a spider analysis. You draw some circles and you start looking at the size of those circles and the question is how much accumulation do you have in there? I think it's a valuable exercise and these modeling companies, the RMSs, the ARRs and EQECATs of the world, and even the brokers have consulting tools that will allow you to understand what your potential accumulations are around targets and also to sort of disbelieve believe these things are targets.

I want to switch gears and talk a little bit about how to build a life and PA cat model from the workers' comp model. My second job when I got to Axis was really to build one of these things. This was because as a post-9/11 company we started writing a lot of things that were not necessarily in our normal bag of tools. You know we weren't life and PA writers prior to 9/11. Corporately we were all P&C people, so we would write property and casualty and not life and PA stuff. So we stepped up and took some risks early in 2002, but we very quickly realized that what we wanted to do was really consider our accumulations and try to provide ourselves with a

method of consistently pricing our capital. We would receive a deal in and we would want to be indifferent as to what it is. It doesn't matter to us whether it's property or workers' comp or personal accident. What matters to us is that we are getting the best return for our shareholders. Equally, the other reason was to make sure that we could accumulate this consistently.

So I suppose you need to step back a little bit. The likes of ARR, RMS and EQECAT built these workers' comp models very soon after 9/11. They had relatively established earthquake models. The issue for them was really that prior to 9/11 they didn't have to form an opinion about the volume collapse as if it were of a building. In an earthquake situation there would be two scenarios. In one scenario the building would collapse and in that scenario everybody in the building would be killed. In the second scenario you still have the total loss on the building, but the structural engineering components meant that the building didn't collapse and the people could get out of the building all right. So they build this component on to their model and then think about the benefits that might be payable in different states for workers' comp.

But if you look inside these models you're able to find that for these given events, for these 10,000 years where we have earthquake scenarios, they have the number of people that will die from each event. You can do some burrowing and you can find out what the working population is and the life population. And as a client you will bring me your life benefit structures, so that filled out the seeds that we need to start to build this model.

Tetlow Slide 1, Page 7 provides a simple example. If we had 10,000 people in a zip code and for this one earthquake that we were looking at we had 100 people die, there's a mortality rate of 1 percent. And if you tell me you have 2,000 people there and that they are worth $100,000 I can work out that, assuming your mortality will be the same as the industry here, will get a $2 million loss. What we need to look at really then is zipping, or putting together all of the zip codes, and all of the different occupancy classes that you might have, and then summing that up for the building class permutation in the earthquake scenario. Now again, that's just one earthquake, so then you need to look at many earthquake scenarios.

What this allows us to do, basically, is to look at a property portfolio where we simulated earthquakes across and a life portfolio where we simulated earthquakes across. And we can look at the relative propensity-produced loss to excess layers, which is what you typically come to us to buy.

We had to do something to try and think about the fact that there is a nighttime exposure for life policies versus work comp. You know there are some workers obviously at nighttime, but predominantly most people work nine to five. We also had to equally think about what we do outside the United States, because this workers' comp model was just for the united States.

We built a proxy as seen in Tetlow Slide 2, Page 8, which was the best proxy we could look at. It was the number of people who had died in these earthquake events relative to the commercial property loss that was experienced. The rationale there being that the workers are probably going to be in commercial property at the time. It was the only real way that we could get to something that was useful for us that allowed us to think about what would happen at nighttime, and what would happen outside the United States. The graph in Tetlow slide 1, Page 9 shows the relationship that we had on the previous graph. And the nice smooth line is the model fitted curve that we ended up using. This sort of curve, which gets markedly more spiky as you go to the left is made up of the real numbers that come out of the model. Now the issue there is that on the bottom of the graph we had the earthquake magnitude. And really what we're getting into here is a sampling issue, so for magnitude 7.9 earthquakes there may only be one in the model. And so the issues associated with where that earthquake struck and where the commercial and working population was may be slightly different from the 7.7 scenarios where there was a little bit of a different ratio. So while it looks a little bit messy toward the left-hand side, I think it's actually a pretty good relationship.

So, as shown in Tetlow Slide 2, Page 9, what we did then is at nighttime look at the personal lines loss to use that relationship that we had at the daytime to imply some kind of death mortality rate. What that looks like can be seen in Tetlow Slide 1, Page 10. One line was actually what was in the model, and then the other line was our attempt through that process to reproduce the first line. It's not bad. It has some spiky stuff over on the right, and on the left it doesn't quite have the severity of the first line, but I thought it was pretty reasonable.

There are issues associated with the density of people in the daytime versus the density of people in the nighttime. There are also issues associated with the fact that you can have 1,000 workers in a building that collapsed, but it is much less likely for the houses of 500 two-people families to collapse. So maybe there's less variability at nighttime.

To look at the rest of the world we looked at different regions in the world and maybe paired them wit places in the United States where the earthquake propensity is similar. So we equated Japan to California and we equated Turkey to the United States for all other areas, apart from California, New Madrid and the Pacific Northwest. We also accounted for differing building qualities, and for a given magnitude we would expect in Turkey the buildings to respond as though the earthquake was one more magnitude than an equal earthquake in the United States.

Now I'm going to discuss cost of capital considerations. We take two approaches for looking at nonprobablistic perils. We look at something called incremental ROE. What that asks is that for a given contract that we are about to write, how does that stress or relieve stress within our portfolio? We also look at the traditional ROE measures, which look at the coefficient of variation. It looks at the ratio of center

deviation of loss to expected loss, and uses that metric to define the amount of capital you need to allocate. We also look at the impact on various return periods.

That's one method we can use. A second method we use is all about how we manage the capital in the first place. We're looking at our accumulations on a total limits basis by state and we're looking at balancing the supply-demand metric that we have. We want to be there to pay for the claim, so it's really looking at the supply and demand we have and deciding what we can charge for our capacity in some regard.

I'm going to talk about some of the things around evaluating functionality of reinsurance. People all say the price is too high, but our approach allows us to provide good value at the moment. When you buy off us, we'll be there to pay for you, given the way TRIA works for the insurance industry. We often ask people why they are buying what they're buying, and why do they think my price is too high? We don't get good discussion on that. For us, I think you should also be asking all through your organization what it matters and if you are buying reinsurance that will be there to pay for a nuclear event. Those are some of the things you should be looking at.

We've already touched on this SPRA pool and the fact that it's not reinsurance, but a pool. In a Towers Perrin workers' comp study they concluded that there isn't the ability to build a pooling system that would appropriately allow for the possible loss scenarios that they could see in the worker's comp industry. I look at group life and I think of it as very similar to worker's comp. The benefit structures are different but, in terms of the exposures it's the same kind of idea.

One of the interesting things I was looking at was the reinsurance of life policies on a proportional basis. Just looking at the ACLI statistics, it seemed to be that 8 percent of the volume for direct writers goes to a small pool of reinsurers. When you look at what that implies for Manhattan, there's a $100 billion aggregate in terms of face value there. I'm not sure what the capital is of the life companies it's ceded to, but it really says to me that there might be an issue here in terms of collectability of contributions to the face values in the event of a nuclear event. I want to highlight that because when something's been around for a long time, you assume they are going to be there, but I'm not sure that's what that meant.

We see a lot of people on the worker's comp side buying a cat. cover but we don't see life companies doing that. I'm not sure why that is.

The other thing to think about that is pretty important is exposure versus experience. There are a lot of people that think because they've never had it, why should they buy it? I'm not sure that's the proper way to think about it. I think you should go through your portfolios and look at what the possibilities of loss are.

Another interesting thing was the Vita Capital deal. It was a Swiss Re deal. I was going through the actuarial analysis to understand what was going on there. I think it comes back to exposure versus experience, but there was a bootstrapping method of looking at the experience over 93 years to generate the losses. If the premium for that deal is equitable to our pricing and how we look at things, that would equate to a total loss once every 200 years. So if you are only looking at 93 years worth of experience, is that really a good way of looking at it?