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making financial sense of the future

Health and Care Conference – Celtic Manor
Lee Lovett & Lourens Fourie



Understanding Catastrophe Risks

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Agenda

- Understanding the RMS model
- Terrorism risks and Group Life
- Disability and terrorism - modelling the impact
- Understanding Group IP terrorism risks – some examples
- Does Group CI cause us any concern?
- Potential implications for the Group Risk market

Setting the scene

- Group Life and catastrophe risks – since 9/11
- Industry moves to control/limit exposures, e.g.
 - Max £100 M Cat limit per scheme
 - Max £XXX M Cat limit per building
 - Max £YYY M Cat limit within ZZZ metre radius
- Broadly consistent approach by all insurers/reinsurers
- No differentiation in limits according to relative risk?
- No differentiation in price according to relative risk?
- What about Group IP/CI?

Is this the most logical approach?

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Joint initiative between Munich Re & RMS

Aims.....

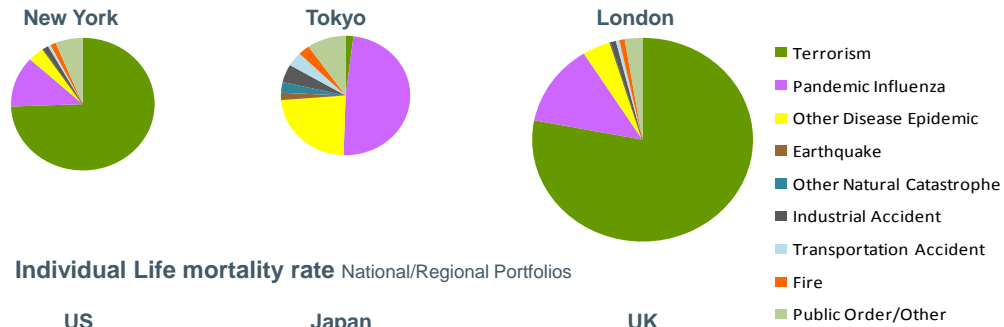
- Better understand the risks we are writing/holding
- More objective/scientific approach to:
 - Setting exposure limits
 - Pricing terror risks
- Produce an approach that is practical and workable in market
- Add value to clients
- Having understood Group Life risks, to then review Group IP (more later)

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A Holistic View of Excess Mortality

Group Life mortality rate Commercial Portfolios in the Central Business Districts of Major Cities

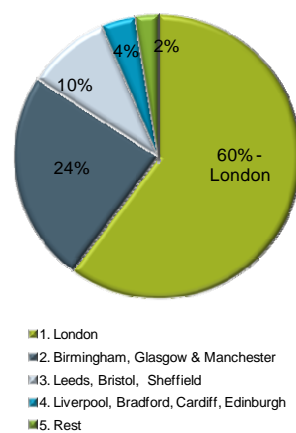


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Why London?

- Accumulation limits can be varied by the relative riskiness of cities
- Strong gradient of risk in the UK
- London represents around 2/3 of total UK risk

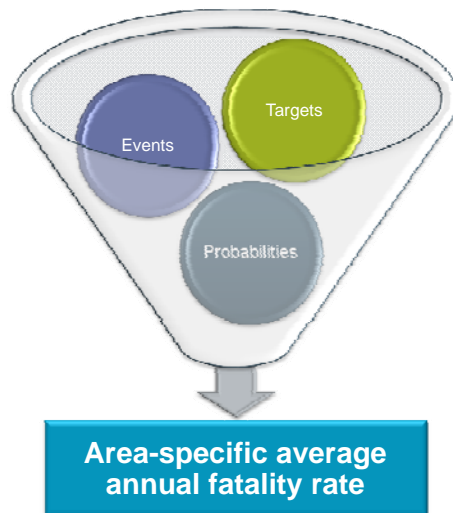
Attack Likelihood By City



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London scheme terrorism analysis

The building blocks

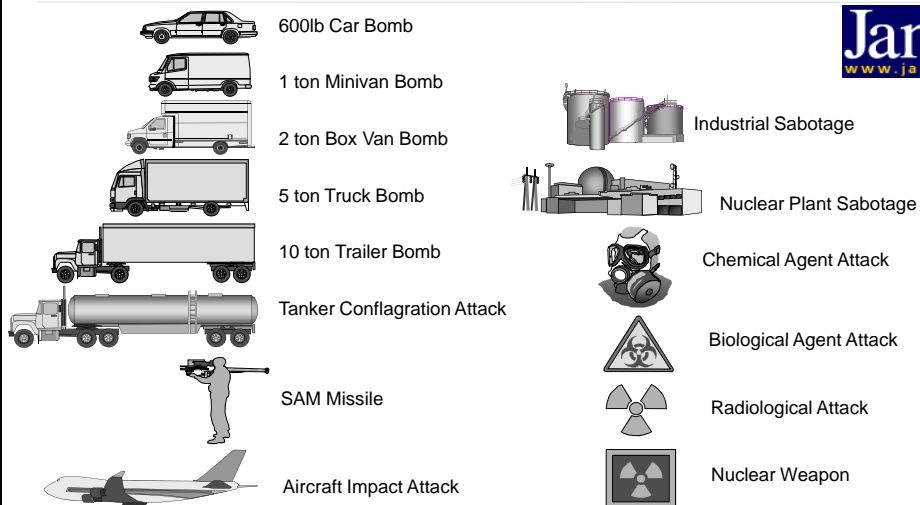


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Modelling Many Different Attack Modes

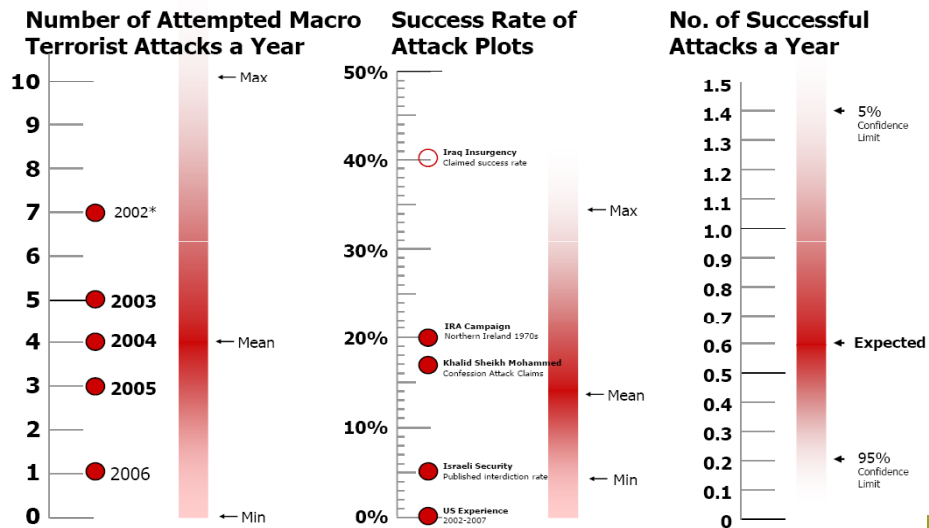
Jane's Information Group
"the closest thing to a commercial intelligence agency"
CBS 60 Minutes

Jane's
www.janes.com

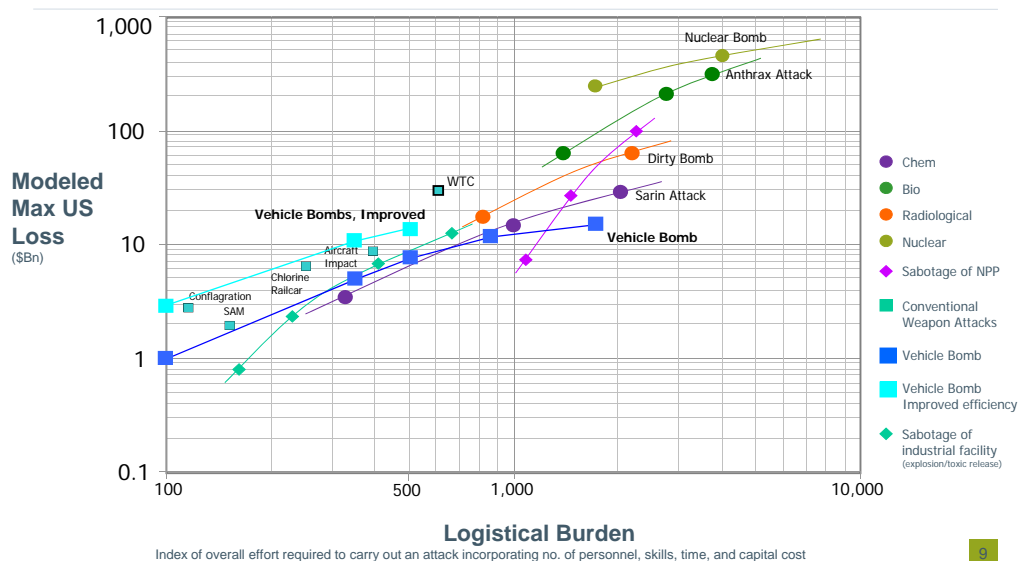


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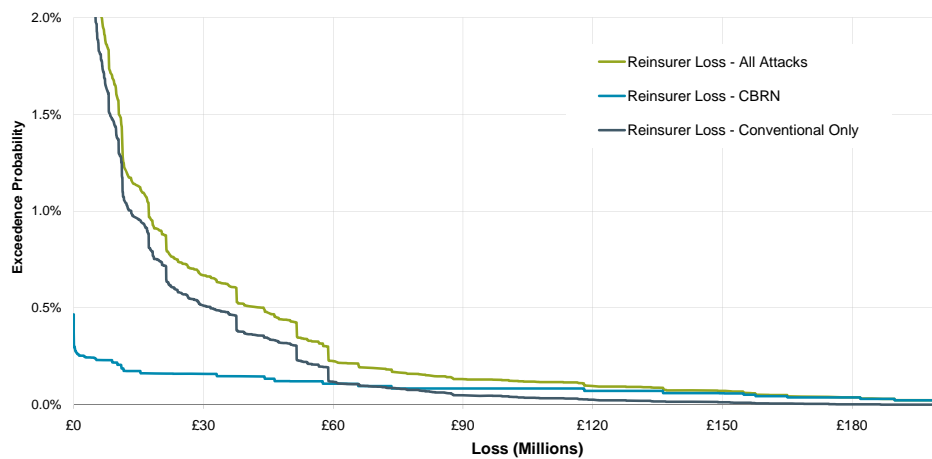
Frequency of attacks – sample data



The Econometrics of Terrorist Attacks



Conventional vs CBRN



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Researching and identifying potential targets



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London Scheme Terrorism Analysis

Definition of Event Set

- **Target List:** 484 Targets (25 Target Types)
- **Attack Modes:** 30 types of attack modes considered
- **Event Set:** Attacks are pairings of target and relevant attack mode. All the attacks make up the London terrorism event set. Total of 4,988 attacks in the London event set.
- **Probability Generator:** The probability of an attack occurring– the event rate– is derived by considering the likelihood of attack mode, likelihood of target, and the frequency of terrorist attacks in the city of interest



Each large circle represents a terrorist attack

The size of the damage circle, which represents the geographic extent to which attack can cause damage, varies by attack mode.

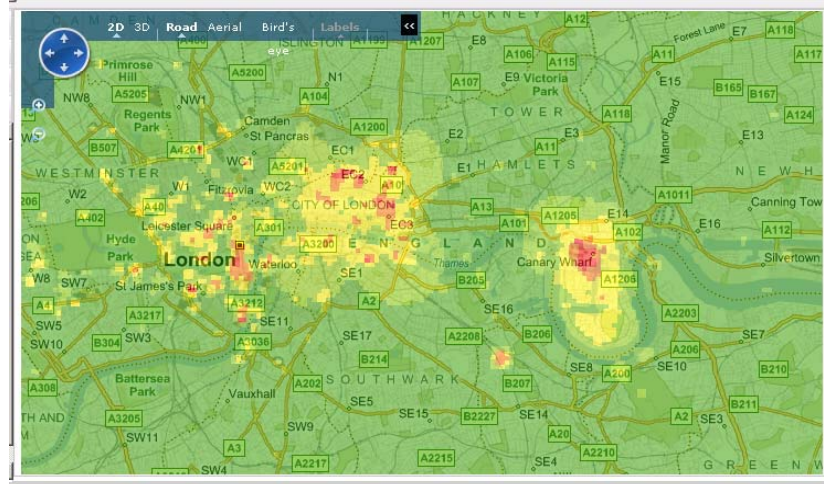
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Analysis output

- **Attack Loss Table**
 - Attacks and corresponding mean losses
 - Does not take any probabilities into account
- **Exceedance Probability Distribution**
 - **Return Period Losses:** Indicates the probability of loss exceeding a certain threshold in any given year.
 - 250-year return period of £ xx M can be interpreted as:
 - Losses can exceed £ xx M once every 250 years
 - There is a 0.4% chance in any given year that losses will exceed £ xx M
 - **Average Annual Loss:** Reflects the amount of loss that can be expected annually from all events that could impact the portfolio. Sum of event losses weighted by probability of occurrence. Calculated at the portfolio level and scheme level.

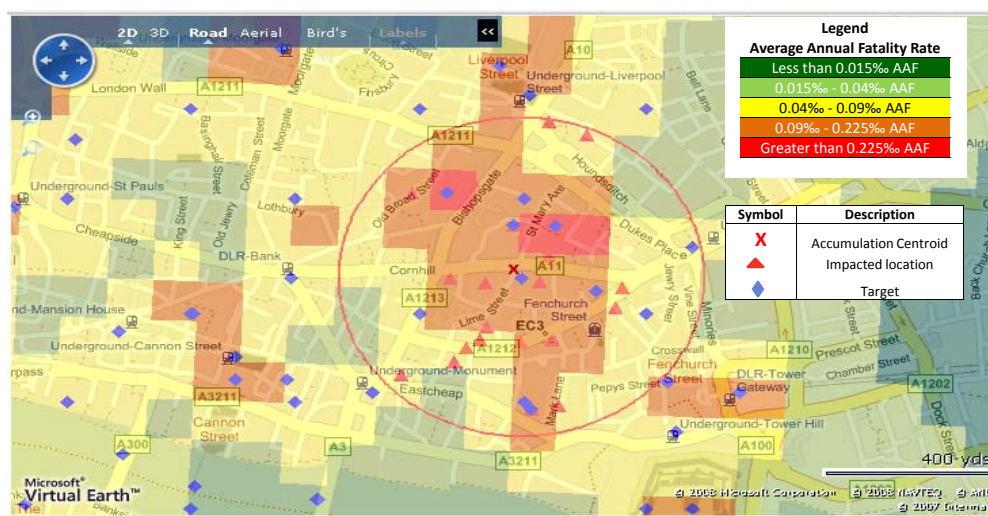
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Average Annual Fatalities: Central London



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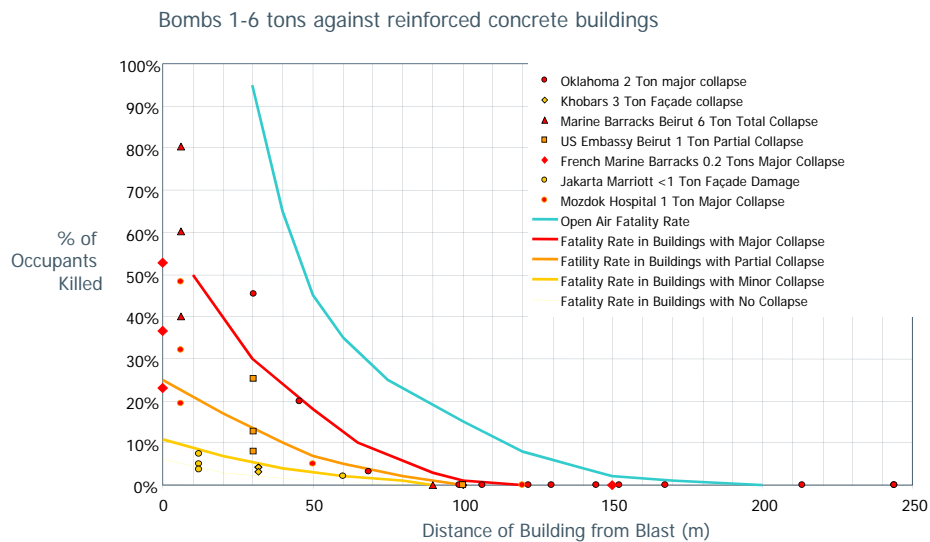
Relative Fatality Risk



Average annual fatality rates can vary by a factor of 60 within a 400 metre ring

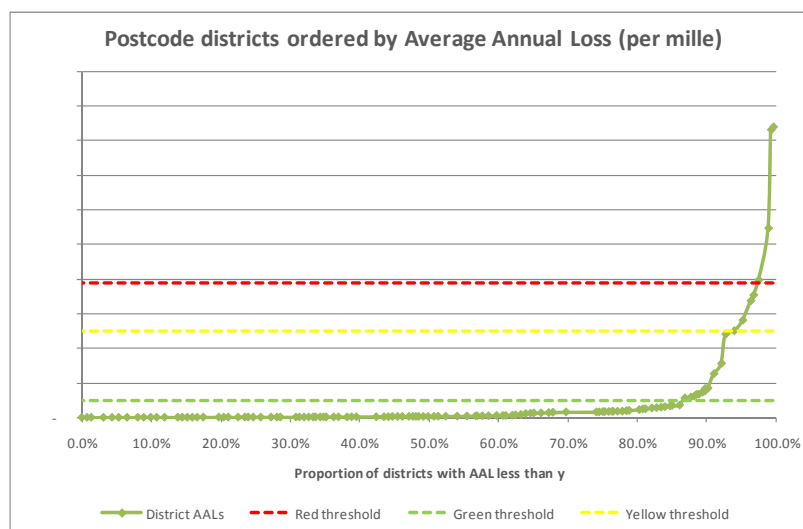
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Casualty Rates in Bomb Attacks



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Terrorism risk by postcode district



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So where did we end up.....?

- Far better understanding of risks within existing portfolio, both in aggregate and exposure to specific risks at specific locations
- A tool to quantify terror risks for any new enquiry
- A more objective basis that allows us to categorise risks according to specific location, leading to:
 - Differential max Cat limits
 - Differential pricing

What about Group IP terrorism risks?

Well, where do we start?

We settled on...



& common sense

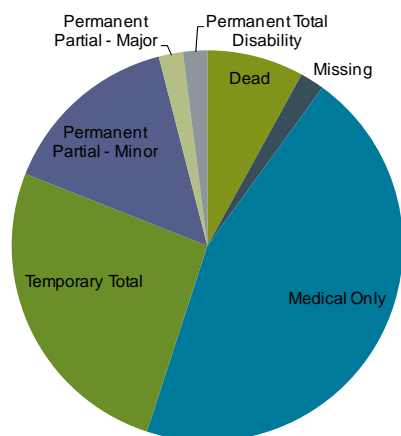
What do RMS consider when modelling casualties?

- As for mortality modelling, consider:
 - type of attack
 - probability of attack (target attractiveness, logistical burden)
- Location
 - construction of building (reinforced concrete, steel, reinforced masonry etc.)
 - height of building (low, mid, high, tall and skyscraper)
For example, highly engineered structures like skyscrapers will have features like particulate filtering for internal air circulation
- Exposure
 - number of lives
 - Sums assured
- Previous events

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Casualties in 07/07/2005 London bombings



Permanent Total and Permanent partial consist of:

- Trauma & tissue loss
- Loss of limbs
- Severe & extensive burns
- Lacerations
- At least 3 cases of eye injury
- Lung and ENT injury

Injury Distribution of approximately 810 occupants of train carriages and bus

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Casualty patterns by location in the Oklahoma City Bombing



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Consider an example company – company specifics

Assumed the same company demographics for each location:

- Total lives: 4500
- Gender split:

Male	Female
54%	46%
- Age distribution:

Age band	Proportion
21 to 30	28%
31 to 40	48%
41 to 50	17%
51 to 65	7%
- Salary distribution

Min	Max	Average
£8,900	£380,000	£42,750

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Group Life and Group Income Protection schemes – what are the costs?

General:

- Financial services company

Group Life (GL)

- Cover: 4x salary
- Total sum assured: £770,308,314
- Total annual premium: £343,000

Group Income Protection (GIP)

- Disability definition: Own occupation
- Specifics: 0% escalation, 26 week deferred period
- Cover: 75% of salary
- Total sum assured: £144,432,809
- Total annual premium: £1,163,000

We will consider the premium figures again when looking at projected terrorism losses.

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How do RMS classify injuries?

Modelling disability:

- Split the effects of a terror event into:
 - Fatalities
 - Permanent total disablement
 - Permanent partial – major
 - Permanent partial – minor
 - Temporary disablement (recover within 6 months)
 - Medical only (recover within weeks)

For GIP, we only concern ourselves with the following categories:

- Permanent total:
 - Disability is severe (100%) and the individual is unable to work ever again. Examples include loss of all limbs, paralysis, etc.
- Permanent partial – major:
 - A permanent injury that results in only partial disability. Examples include loss of a leg, loss of an eye, etc.
- Permanent partial – minor:
 - A permanent injury that results in only partial disability, but less severe than the above. Examples could include loss of a toe, finger, respiratory problems, etc.

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An example – company based at 25 Canada Square

RMS modelling results:

- The following figures assume payment of 75% of pre-disability salary (being paid for 1 year only)

Return Period	E14 SLQ		
	Conventional Only		
	Permanent - Minor	Permanent - Major	Permanent - Total
250	2,068,595	1,086,674	186,578
2,000	11,022,988	6,496,205	3,146,147

- Where:
 - Conventional Attacks include: Bombs, Aircraft Impact, Conflagration, Industrial Plant Sabotage (explosion only)

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But these figures are only for one year, and only cover those physically injured

- We need to consider that a GIP claim can be paid for many years

So, how long will they claim for?

- Permanent Total will claim up to retirement, but we need to adjust for mortality
- Permanent partial (major and minor) can be grouped together:
 - From a physical point of view, most of these claimants can recover and return to work after a year
 - From a psychological point of view, many will be off work for a substantial period of time, suffering from post traumatic stress disorder (to varying degrees) (PTSD)

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Understanding PTSD

- In 1976 a major explosion hit Norway's largest paint factory. There were:
 - 6 fatalities
 - 125 survivors
 - 21 had minor injuries
 - 2 had severe injuries
- Lars Weisaeth, MD, PhD, conducted a study on the survivors, analysing their levels of post traumatic stress
- Dr Weisaeth is Professor and Head, Division of Disaster Psychiatry (University of Oslo).



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Categorising the survivors

- Dr Weisaeth split the survivors into the following categories:
 - Group A – those closest to the explosion, making up the high stress exposure group
 - Group B – those in the outer locations, not near the explosion but at work. They make up the medium stress exposure group
 - Group C – those not at work at the time of the explosion, making up the low stress exposure group

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What were the findings?

Group	PTSD	1 week	7 Months	2 years	3 years	4 years
A	Severe	29%	11%	9%	8%	
	Marked	8%	20%	9%	5%	
	Moderate	6%	6%	9%	9%	
	Total	43%	37%	27%	22%	19%
B	Severe	7%	2%	2%	2%	
	Marked	7%	10%	2%	0%	
	Moderate	9%	5%	9%	2%	
	Total	23%	17%	13%	4%	2%
C	Severe	3%	0%			
	Marked	3%	1%			
	Moderate	4%	3%			
	Total	10%	4%	0%	0%	3%

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What does this mean for claim durations?

- Severe PTSD still present after 3 years will most likely persist up to retirement
- Adjust duration to retirement for mortality, using impaired lives mortality
- The proportion of lives with a marked level of PTSD are assumed to claim for 2 years only

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Consider a 1 in 250 year event

- Grossing up the numbers for duration is done as follows (using the 1 year numbers shown earlier):

	£14 5LQ		
Return Period	Conventional Only		
	Permanent - Minor	Permanent - Major	Permanent - Total
250	2,068,595	1,086,674	186,578

- Average annual benefit: £32,096
- Total injured: 64 (minor), 34 (major), 6 (total)
- Total in group A: 104
- Total group B: 3,704 (with annual benefit £118,881,694)
- Total group C – assume 15%: 675
- Deaths 17

This assumes every life is an average life

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Still considering the 1 in 250 year event

- Average benefit weighted time to retirement: 29.40 yrs
- Mortality adjusted time to retirement: 18.06 yrs
 - This factor is applied to all permanent and total claims
- A factor of 2.46 is applied to all minor and major claims who form part of group A
- A factor of 0.40 is applied to the total benefit of those in group B
 - This is to reflect those who would suffer from severe PTSD and who would claim up to retirement

TOTAL LOSS: £58,842,041 (1 in 250 year event)

Roughly 50x annual GIP premium

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Still the paint factory - what did he observe?

Group	PTSD	1 week	7 Months	2 years	3 years	4 years
A	Severe	29%	11%	9%	8%	
	Marked	8%	20%	9%	5%	
	Moderate	6%	6%	9%	9%	
	Total	43%	37%	27%	22%	19%
B	Severe	7%	2%	2%	2%	
	Marked	7%	10%	2%	0%	
	Moderate	9%	5%	9%	2%	
	Total	23%	17%	13%	4%	2%
C	Severe	3%	0%			
	Marked	3%	1%			
	Moderate	4%	3%			
	Total	10%	4%	0%	0%	3%

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Why are we looking at a 1 in 250 year event?

What guidelines does your Company use?

- Capital requirements
- Internal risk management guidelines
- Regulatory

Other 1 in x year losses are:

- Total loss from a 1 in 2,000 year event: £121,682,311

and for All Attacks:

- All Attacks include: Bombs, Aircraft Impact, Conflagration, Industrial Plant Sabotage (explosion only), **Industrial Plant Sabotage (vapour release), Biological (Anthrax), Chemical (Sarin Gas), Nuclear Bomb, Radiological Dispersion (Dirty Bomb)**

- Total loss from a 1 in 250 year event: £63,037,601
- Total loss from a 1 in 2,000 year event: £131,101,997

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What about specific events - consider 25 Canada Square?

Figures in the boxes represent 1 years claims, assuming a 75% of salary benefit

E14 5LQ		
Large bomb - 2 Ton		
Permanent - Minor	Permanent - Major	Permanent - Total
20,031,823	11,115,191	5,461,069

Total cost: £195,863,708

More than 165 x annual GIP premium

E14 5LQ		
Sarin gas - large outdoor release		
Permanent - Minor	Permanent - Major	Permanent - Total
36,930,025	34,795,308	20,692,889

Total cost: £ 557,733,421

More than 475 x annual GIP premium

Haymarket bomb attempt 2007



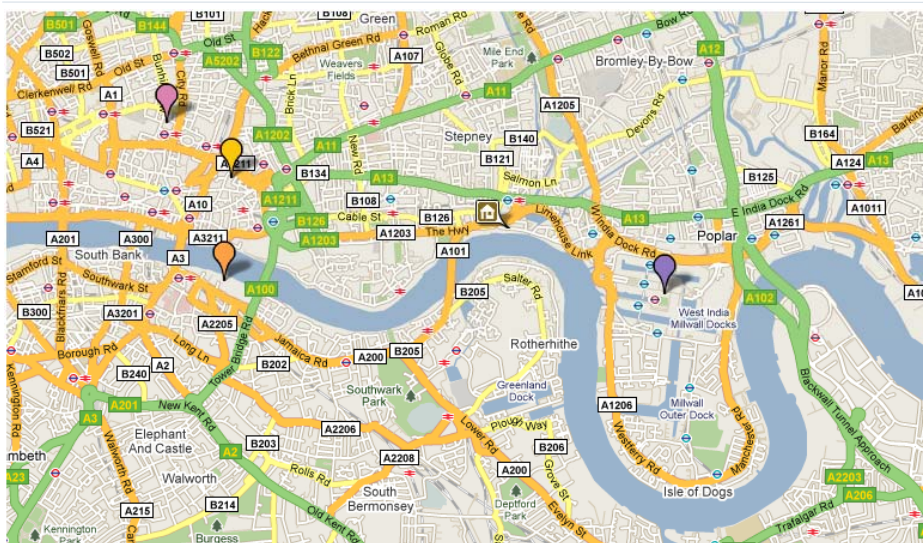
Tokyo Sarin Gas attack 1995



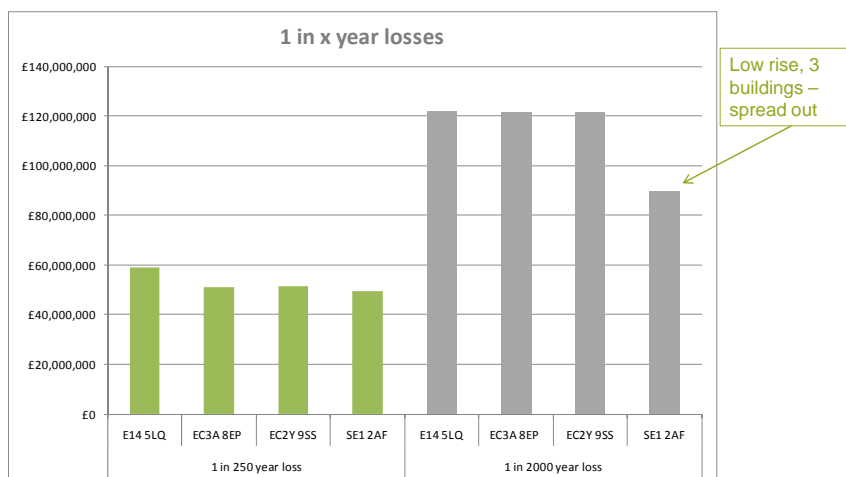
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How do the costs differ by location?



And how do the different locations compare?



These figures are for conventional attacks only

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Should we be concerned about Group CI?

Critical Illness

- Assuming 4x salary cover for critical illness, we get the following figures:

Return Period	E14 5LQ
	Critical Illness claims
250	6,790,675
2,000	51,425,877
Sarin Gas (large release)	82,771,554

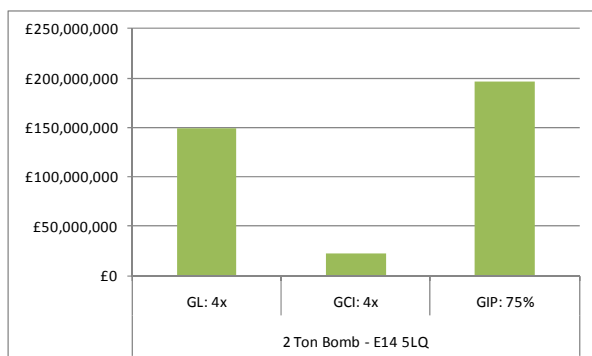
- These figures only convert the projected Permanent Total disabled into CI claims. There may be more claims for:
 - Cancer (if radiological cause)
 - Loss of single limbs
 - Burns
 - Loss of sight/hearing etc.

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Overall Group Risk impact?

- Considering the same example as before (a 2 ton bomb at 25 Canada Square):



TOTAL LOSS: £366m

GIP premium: £343k

GL premium: £1,163k

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What does this all mean for the Group market?

Group Life:

- Use of catastrophe limits is well established good practice and should continue
- But... should offices differentiate pricing and limits to reflect actual catastrophe (terror) risk?

Group IP:

- Some concerns for high exposures in high risk locations, especially if there is GL exposure as well
- Should perhaps also reflect on accumulation of risks within a defined area
- But... practical issues:
 - how do you limit risk/exposure (annual benefit or total claims costs?)
 - can a direct cause and effect relationship be established?

Group CI:

- Unlikely to be of concern given it's a relatively small market
- But... may wish to review position if large GIP/GL exposure for same scheme in a high risk location?

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Conclusion

- This is not an exact science, but
- is more scientific and objective than the crystal ball we showed you earlier, and
- hopefully provides some food for thought.

Your view on the need to limit your exposure when a catastrophe occurs depends on your risk appetite, capital, reinsurance arrangements, etc.

If it were my money, I'm sure I would want to limit my exposure...

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Questions or comments?



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