TERRORISM MODELING

UNIT 5

RMS® CCRA® Training Program

CCRA
Certified Catastrophe Risk Analyst

RMS

AGENDA

- Unit 1: Understanding Terrorism Risk
- Unit 2: Terrorism Modeling Overview
- Unit 3: Terrorism Hazard Module
- Unit 4: Terrorism Vulnerability Module
- **Unit 5: Terrorism Financial Modeling**
- Unit 6: Probabilistic Terrorism Modeling

RMS

UNIT 5:
TERRORISM
FINANCIAL
MODELING

Learning Objectives

- Understand specific financial modeling assumptions used in terrorism models that can affect how to code financial structures as well as how to interpret results
- Identify areas in terrorism models where financial modeling is different from natural peril models
- Understand financial terms of the federal Terrorism Risk Insurance Program Reauthorization Act of 2007 (TRIPRA)

At the end of this unit you should have a good understanding of each of the five learning objectives listed on this slide.

FRAMEWORK FOR TERRORISM MODELING

Exposure at Risk
- Property exposed
- Population exposed
- Geocoding
- Building Attributes

Quantify Hazard
- Pressure waves
- Contaminant dispersal
- Debris
- Fire

Assess Vulnerability
- Distance vs. damage
- Impact of hazard on the building environment
  - Building Damage
  - Nature of injuries

Probabilistic Analysis
- Relative likelihood of scenarios
- Multiplicity of attacks
- Frequency of attacks

In the overall framework for modeling terrorism, terrorism financial modeling comes after total exposures flow through both the hazard and vulnerability model and generate a ground up loss for specific terrorism scenarios. This unit specifically focuses on how ground up losses from terrorist attacks flow through insurance and reinsurance financial structures, including TRIPRA in the U.S.

Terrorism is a relatively new peril that can generally be modeled using existing financial modeling frameworks already in place for natural perils. There are aspects of modeling terrorism risk, however, that require different data coding and modeling solutions. Some examples of questions that should be considered before modeling financial structures as well as interpreting results from terrorism include:

1. How is an event occurrence defined? Are financial structures such as policy and reinsurance deductibles and limits applied to single attacks or to multiple "swarm" attacks?

2. Are financial modeling features in terrorism models the same as natural perils?

3. How does the U.S. Terrorism Risk Insurance Program Reauthorization Act (TRIPRA) affect your financial modeling options? TRIPRA was extended through the end of 2014. This legislation requires insurers to offer terrorism coverage for specified commercial property and workers compensation lines. In turn, the government provides a "reinsurance backstop" for those commercial property and WC writers that take on terrorism exposure.

These are some of the questions that we will address in this unit.

We will start off with a discussion on the single vs. multiple occurrence question. The single vs. multiple occurrence question in policy and reinsurance language is not a new one posed by terrorism. For example, consider an asbestos exposure case where the courts were asked to determine if each exposed asbestos worker was a single occurrence under a bodily injury insurance policy or whether the exposure of all workers from a specified asbestos product line constituted a single "occurrence." In one particular case where this was put to the test, courts ruled that each individual exposure was its own occurrence – which in other words would be a "multiple occurrence" ruling.

A similar question was posed for the World Trade Center (WTC) attacks after two distinct airplane attacks occurred on the North and South Towers separated by less than half an hour on the morning of September 11, 2001. The WTC case became known as the $3.5 billion question since the occurrence limit in question was that amount. Ultimately, it was decided in the courts based on the terminology in the contract. Some policies were interpreted to consider the WTC attacks as a "single occurrence" subject to a single limit payout, while others ruled that the WTC attacks were a "multiple occurrence" subject to two limit payout.

The single vs. multiple occurrence question poses a challenge to modeling terrorism risk since single occurrence definitions of coordinated swarm attacks would require policy and reinsurance deductibles and limits to be applied to losses after considering the swarm (for example, the WTC policy would cover the combined losses from the North and South Towers as a single loss). RMS' approach to modeling coordinated swarm attacks is to account for the swarm during EP curve generation which can be done analytically but results in the loss of event specificity. This can be problematic since it means that users can no longer tie an event to a particular series of targets and attack modes.

In order to preserve attack specificity, all policy, per-risk and catastrophe reinsurance financial modeling is applied before the EP curve generation using the assumption that each attack in the attack loss table is its own occurrence. Users should note that this financial modeling assumption which treats each attack as its own occurrence would be a "multiple" occurrence definition. This is an important assumption to understand both when coding financial structures and when interpreting model results.

Note that RMS does provide the option to apply financial terms post-swarm by modeling RMS stop loss treaties. RMS stop loss treaties are applied to the final EP curve instead of to each individual attack. The main disadvantage of this solution is that you lose the ability to look at event losses tied to specific targets and attack modes.

FINANCIAL MODELING: TERRORISM VS. NATURAL PERILS

- Financial modeling for terrorism is similar to that used in natural perils
  - Ground up → Gross → Net after reinsurance → is similar
  - Since terrorism is a new peril, financial model differences do exist
- Examples of financial model variations in RMS products:

	Probabilistic Terrorism Model	RiskLink® Terrorism Scenario Model & Accumulation Mgmt.
▪ Policy level deductibles, limits, part of & reinsurance	√	√
▪ Cat, corporate cat & stop loss treaties	√	√
▪ WC financial modeling	√	Ground Up Only
▪ Secondary uncertainty (standard deviation)	√	n/a
▪ Financial modeling in "distributed" mode	√	Expected Mode Only
▪ Location level limits, deductibles	√	√
▪ Account and location level reinsurance	n/a	√
▪ Policy min/max deductibles, special conditions, by coverage	n/a	√
▪ Reinsurance reinstatements and % retention	n/a	√
▪ WC employee groups & shift information	n/a	√
▪ Currency conversions at runtime	√	√

CCRA® Training Program – RiskLink® Version 11.0   © 2014 CONFIDENTIAL   RMS
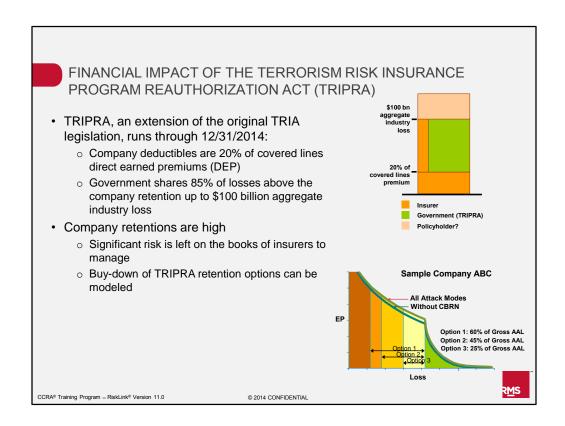
Another consideration to make when thinking about how to code financial structures and interpret results for terrorism is to identify where differences exist compared to the other natural peril financial models that you are accustomed to working with. Though conceptually the way ground up loss flows through to gross loss and net loss after reinsurance is treated similarly to other natural peril models, terrorism solutions are relatively new so not all financial modeling will be the same. To some degree, financial modeling for terrorism is still evolving much in the way that earthquake and hurricane peril financial models were growing in the 1990s after the Loma Prieta and Northridge earthquakes and Hurricane Andrew.

Some examples of how financial modeling can be different than natural perils specifically for RMS products are shown in this table. To highlight a few key points on this slide:

1. The RMS Probabilistic Terrorism Model (which we often refer to as PTM) considers policy per-risk reinsurance and portfolio reinsurance financial modeling as well as policy level and location level financial structures. Account level and location level reinsurance are not considered at this time. PTM does fully model uncertainty (or standard deviation around the mean loss for each attack loss) so financial modeling can be done in "distributed mode" in the same way it is done for natural perils.

2. On the other hand, the RiskLink Terrorism Scenario modeling (and accumulation management functionality) includes the full suite of financial modeling at location, policy, account, and portfolio levels (property only) that are available for other RMS natural perils but does not include standard deviation calculations so all financial modeling is done in "expected mode."

These are just a few examples that illustrate how terrorism financial modeling is continuing to evolve. RMS expects that terrorism financial modeling will eventually fully catch up to other financial modeling that is available for other perils.
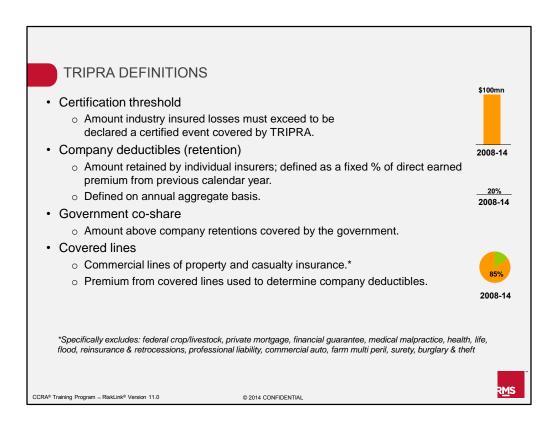
Another consideration to make in terrorism financial modeling is to look at the financial impact of TRIPRA on a company's portfolio.

To provide some background, the Terrorism Risk Insurance Act (TRIA) was legislation that was established just after 9/11 to provide a temporary federal program to provide shared public and private compensation for insured losses resulting from a future act of terrorism. It was originally intended to provide a transitional period for private markets to stabilize and build capacity while providing important immediate coverage for business owners and new construction projects just after 9/11. In return for a federal reinsurance backstop for terrorism losses, insurers are required to offer terrorism coverage to all policyholders. TRIA specifically states that under the program, insurers must "make available" coverage for terrorism that is commensurate with other coverage provided on existing policies. For example, if a standard wind/fire policy is issued, terrorism can not be excluded from coverage by that policy. Policyholders have the option to decline terrorism coverage if desired. Companies are also allowed to exclude CBRN (chemical, biological, radiological, nuclear) coverage for property lines if existing policy coverage already had existing exclusions in place for other causes of loss (e.g. if a nuclear exclusion was already in effect).

TRIA was twice extended (referred to as TRIEA) and remained in place through end of 2007. A more recent extension at the end of 2007, TRIPRA, extends this through the year 2014. As shown in the top picture of this slide, in 2011, TRIPRA (shown in green) is an 85% prorata agreement that attaches at 20% of each company's covered lines premium. TRIPRA covers up to a $100 billion industry aggregate gross loss in a year.

Though most commercial property and workers comp writers are covered in part by TRIPRA for terrorism policies in place, individual company retentions are extremely high and significant risk is left on the books of insurers to manage. The graph on the bottom of this slide shows potential TRIPRA "buy-down" reinsurance options for Sample Company ABC. Note that in this example, more than 80% of the company's expected loss from terrorism falls below the defined TRIPRA retention amount for this company.

TRIPRA DEFINITIONS

$100mn

2008-14

- Certification threshold
  - o Amount industry insured losses must exceed to be declared a certified event covered by TRIPRA.
- Company deductibles (retention)
  - o Amount retained by individual insurers; defined as a fixed % of direct earned premium from previous calendar year.
  - o Defined on annual aggregate basis.

20%
2008-14

- Government co-share
  - o Amount above company retentions covered by the government.
- Covered lines
  - o Commercial lines of property and casualty insurance.*
  - o Premium from covered lines used to determine company deductibles.

85%

2008-14

Specifically excludes: federal crop/livestock, private mortgage, financial guarantee, medical malpractice, health, life, flood, reinsurance & retrocessions, professional liability, commercial auto, farm multi peril, surety, burglary & theft

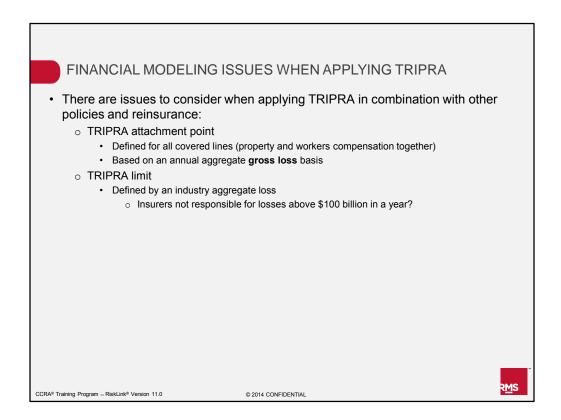CCRA® Training Program – RiskLink® Version 11.0   © 2014 CONFIDENTIAL   RMS

The TRIPRA program specifically covers **certified** acts of terrorism. TRIPRA certification is defined in the legislation as an act of terrorism against U.S. targets resulting from individuals who operate on behalf of a foreign or domestic terrorist group. In order to be certified, the event must cause an industry gross loss above a **certification threshold**. In the original bill, the certification threshold was $5 million. The TRIEA extension increases the trigger amount to $50 million in 2006 and $100 million in 2007. TRIPRA maintains the $100 million threshold through 2014. It is worth noting that industry-wide terminology of "certified" vs "non-certified" events is based on this TRIPRA definition. In general, the RMS model bases its stochastic attack set on those types of events that would trigger TRIPRA.

Other key TRIPRA definitions outlined in the bill are the **company deductibles** defined as a % of direct earned premiums from the prior calendar year for all TRIPRA covered lines (20% in 2007, continuing through 2014). Company deductibles are based on an annual aggregate gross loss basis which means that if multiple events occur in a year, the company deductible is determined based on the total loss from all those events (instead of for each event separately). The **government co-share** defines the percentage the government covers above the company deductible. It was 85% in 2007 and will remain at that level through 2014.

TRIPRA **covered lines** are specified in detail in the legislation and in general cover commercial lines of property and casualty business including workers' compensation but excludes reinsurance and retrocessions. TRIPRA also specifically excludes professional liability, commercial auto, farm multi-peril, surety, and burglary and theft lines from coverage.

FINANCIAL MODELING ISSUES WHEN APPLYING TRIPRA

- There are issues to consider when applying TRIPRA in combination with other policies and reinsurance:
  - TRIPRA attachment point
    - Defined for all covered lines (property and workers compensation together)
    - Based on an annual aggregate **gross loss** basis
  - TRIPRA limit
    - Defined by an industry aggregate loss
      - Insurers not responsible for losses above $100 billion in a year?

The main financial modeling challenges that TRIPRA coverage poses are:

1. The TRIPRA attachment point is defined for all covered lines which includes commercial property, workers compensation, as well as other lines including liability. In addition, the attachment point is defined on an annual aggregate gross loss basis. In order to model these two conditions, covered lines losses should be grouped together and the TRIPRA attachment should be applied to the gross loss (prior to other reinsurance) from the combined lines for all events occurring in a year.
2. The TRIPRA limit is defined by an industry aggregate gross loss amount of $100 billion. The TRIPRA legislation hardened this cap and made it clear that insurance companies would not be responsible for losses in excess of this amount.

The following slide illustrates RMS' suggested approach to modeling TRIPRA alongside other reinsurance for multi-line portfolios.
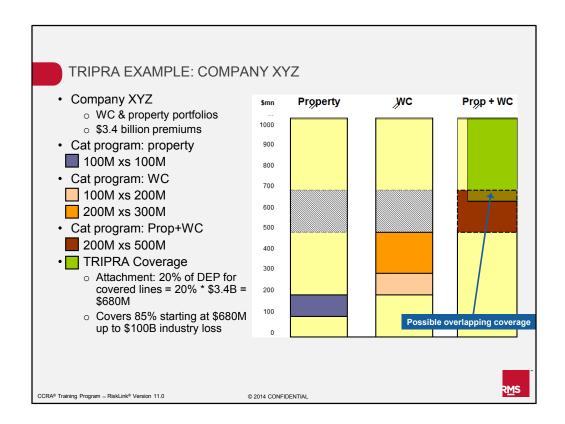
This workflow takes into consideration that TRIPRA terms are based on an annual aggregate gross loss and that it is a multi-line cover. It also has the advantage of allowing companies to assess their net losses if, in fact, TRIPRA is a temporary program that eventually sunsets after 2014.

In general, the suggested workflow consists of four main steps:

1. First, insurers should review all reinsurance layers modeled to consider if any non-TRIPRA coverage should be modified based on the TRIPRA retention. For instance, the TRIPRA retention could be used to re-define existing catastrophe program layers to minimize overlap of reinsurance coverage. Reinsurers may also want to assess if they are writing coverage that overlaps with TRIPRA since in the case of overlap, TRIPRA payouts could be subject to reimbursement by the reinsurer since insurers would not be able to recover from both TRIPRA and reinsurers for the same layer coverage.

2. Second, RMS suggests modeling all non-TRIPRA reinsurance for property and workers comp lines first **without considering TRIPRA coverage**. Note that depending on a company's reinsurance purchasing strategies, non-TRIPRA reinsurance may cover separate or combined property and workers compensation coverage. Separating non-TRIPRA reinsurance coverage from TRIPRA coverage is not only necessary to model TRIPRA properly (since TRIPRA should apply to gross losses prior to other reinsurance) but also has the advantage of generating results that a company can use to assess loss results if TRIPRA coverage does eventually go away.

3. The third suggested step is to assess TRIPRA recoveries. This step is mainly for primary insurers and is not as important for the reinsurer. To properly assess TRIPRA recoveries, TRIPRA (as defined by the terms for a given year) should be applied to property and workers compensation combined gross aggregate losses. In RMS terms, TRIPRA would apply as an RMS "stop loss" treaty that applies to the total grouped property plus workers compensation AEP gross losses (no other reinsurance included).

4. To look at the combined non-TRIPRA and TRIPRA results, take the net loss (post non-TRIPRA reinsurance from step 2) and subtract the TRIPRA recovery from step 3.

The next slides will show an example of how TRIPRA and non-TRIPRA reinsurance could apply to a sample company given a particularly active year of terrorism events.
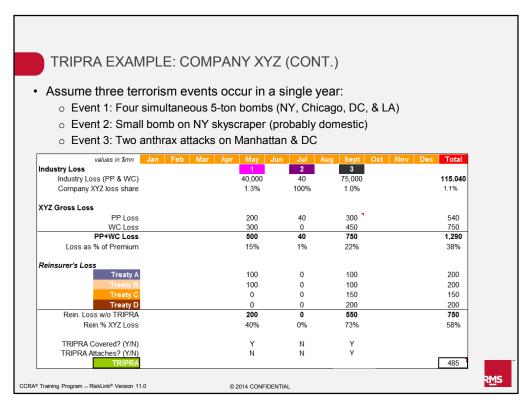
- Company XYZ
  - WC & property portfolios
  - $3.4 billion premiums
- Cat program: property
  - 100M xs 100M
- Cat program: WC
  - 100M xs 200M
  - 200M xs 300M
- Cat program: Prop+WC
  - 200M xs 500M
- TRIPRA Coverage
  - Attachment: 20% of DEP for covered lines = 20% * $3.4B = $680M
  - Covers 85% starting at $680M up to $100B industry loss

$mn — Property — WC — Prop + WC
1000, 900, 800, 700, 600, 500, 400, 300, 200, 100, 0

Possible overlapping coverage

To provide an illustration of some of the issues to consider when applying TRIPRA alongside non-TRIPRA reinsurance, here is an example using Company XYZ, a commercial insurer with both property and workers compensation exposure. The company has approximately 2% market share of all TRIPRA covered lines premiums – or approximately $3.4 billion premiums.

Company XYZ has multiple cat programs: one covering property only ($100 xs $100 million); another workers compensation covering two layers ($100 million xs $200 million and $200 million xs $300 million). In addition, they have a combined property and workers compensation cat program that covers a higher layer ($200 million xs $500 million).

Based on the TRIPRA terms, the TRIPRA coverage for XYZ is 20% of covered lines premiums (of $3.4 billion) so the company deductible computes to $680 million. TRIPRA covers 85% of losses above $680 million until industry aggregate losses reached $100 billion. There is some ambiguity on how to code an occurrence limit for TRIPRA coverage given that the limit is based on an industry aggregate gross loss. In general, RMS uses the practice of coding TRIPRA limits as $100 billion minus the company deductible.

- Assume three terrorism events occur in a single year:
  - Event 1: Four simultaneous 5-ton bombs (NY, Chicago, DC, & LA)
  - Event 2: Small bomb on NY skyscraper (probably domestic)
  - Event 3: Two anthrax attacks on Manhattan & DC

values in $mn	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Industry Loss					**1**		**2**		**3**				
Industry Loss (PP & WC)					40,000		40		75,000				**115.040**
Company XYZ loss share					1.3%		100%		1.0%				1.1%
XYZ Gross Loss													
PP Loss					200		40		300				540
WC Loss					300		0		450				750
PP+WC Loss					**500**		**40**		**750**				**1,290**
Loss as % of Premium					15%		1%		22%				38%
Reinsurer's Loss													
Treaty A					100		0		100				200
Treaty B					100		0		100				200
Treaty C					0		0		150				150
Treaty D					0		0		200				200
Rein. Loss w/o TRIPRA					**200**		**0**		**550**				**750**
Rein % XYZ Loss					40%		0%		73%				58%
TRIPRA Covered? (Y/N)					Y		N		Y				
TRIPRA Attaches? (Y/N)					N		N		Y				
TRIPRA													485

To further illustrate some of the issues covered in this unit, we will consider a hypothetically active terrorism event year where there are three distinct terrorism events that occur.

First, Event 1 is a coordinated swarm attack in May that is made up of four 5-ton bomb attacks in NY, Chicago, Washington D.C., & Los Angeles simultaneously.

- Event 1 causes a total industry gross loss of $40 billion. Company XYZ experiences $200 million in property loss and $300 million in WC loss. Given XYZ's loss, only treaty A and B attach
- Note that for this example, each event is treated with a single occurrence definition. The treaty results would look different if the treaty terms were applied to each attack separately.
- This is a certified TRIPRA event, but for company XYZ no TRIPRA recoveries are due since the combined property + WC gross loss is below the company deductible of $680 million.

Two months after Event 1, another bomb attack occurs at a major skyscraper in Manhattan that is smaller in scale

- Event 2 causes $40 million of industry gross loss – 100% of which happens to belong to Company XYZ. None of the treaties attach.
- This is not a TRIPRA certified event since the industry gross loss falls below the certification threshold of $100 million

Just when we thought the worst was over, Event 3 occurs two months later. This time, two anthrax releases are successfully deployed in Manhattan and DC.

- Event 3 causes $75 billion of industry gross loss of which XYZ experiences a $300 million property and $450 million WC loss. All treaties attach, including treaty D which covers combined property + WC lines.
- This is a TRIPRA certified event since the industry gross loss exceeds the trigger. The annual aggregate gross loss for Company XYZ ($500 million from Event 1 + $750 million from Event 3 = $1.25 billion) is greater than the company TRIPRA deductible, TRIPRA attaches and the total TRIPRA recoverable would be ($1.25 billion – $680 million) * 85% = **$485 million**

Note that there is some uncertainty whether or not the full TRIPRA recoverable would be paid out to XYZ since the TRIPRA program only covers up to a $100 billion industry gross loss (which is exceeded after Event 3 occurs). If TRIPRA does pay out the full amount to Company XYZ, note that the reinsurer for Treaty D may be eligible for reimbursement for the overlapping portion of loss from Event 3. This is a case of having an overlapping Prop + WC Cat program and TRIPRA layer. Note that it is not clear if XYZ would be covered under TRIPRA given that industry gross losses > $100 billion, so the overlapping coverage is not necessarily bad.

RMS

This slide summarizes the key points from Unit 5. If any of these points are unclear, please revisit the associated slides within the unit.