# Catastrophe Loss Analysis Service

New York Terrorism and Earthquake Final Report

Prepared for the New York Compensation Insurance Rating Board



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# Introduction

This report documents the results of AIR Worldwide Corporation's (AIR) Catastrophe Loss Analysis Service (CLAS™) for the New York Compensation Insurance Rating Board (NYCIRB). The report includes estimates of New York state average annual losses from terrorism and earthquake for possible inclusion in a workers' compensation loss cost filing.

The report will help the NYCIRB to:

- Identify average annual workers' compensation losses from terrorism and earthquake events.
- Compute average annual workers' compensation loss costs per $100 payroll for both terrorism and earthquake events.
- Understand the impact of TRIA on New York workers' compensation insurers' loss, considering TRIPRA as well as the proposed Senate and House reauthorization bills.

The AIR Industry Exposures Database was used to estimate statewide workers' compensation exposures. The Industry Exposure Database includes: property locations, building, construction and occupancy characteristics, number of employees at each location, and hourly shift assumptions. Workers' compensation severities were estimated using data provided by the NYCIRB and standard actuarial techniques. New York state losses were modeled separately for the terrorism and earthquake perils using Touchstone® and simulating 500,000 and 100,000 years, respectively, of catastrophic losses by location.

In addition to calculating gross modeled loss, AIR modeled the impact of TRIA on NYCIRB losses under three scenarios: the current plan, TRIPRA, the U.S. Senate bill and the House of Representatives' bill.

# Executive Summary

For this study, AIR simulated 500,000 years of terrorism activity and 100,000 years of earthquake activity. This represents 500,000 and 100,000 possible iterations of the next one year of hazard activity for the perils of terrorism and earthquake, respectively.

The results of this analysis are long-term average annual workers' compensation losses (AALs) that reflect the annual amount of loss for the state of New York, on average, over a period of many years. Significant events may not happen every year; thus it is important to emphasize that the AAL presented here is a long-term expected loss. The AAL is calculated by adding the modeled loss for each year simulated and dividing by the number of simulated years, equal to 500,000 and 100,000 years in the case of the terrorism and earthquake perils, respectively. Aggregate AALs reflect the average losses resulting from all events that occur during each simulated year.

For the terrorism peril, losses were modeled on a gross loss basis as well as net of the current TRIA program (TRIPRA) and the proposed Senate Bill S.2244 and House Bill H.R. 4871. Losses net of TRIA were modeled based on the countrywide market shares for TRIA eligible lines and the New York workers' compensation market shares of the largest fifteen writers of workers' compensation in the state of New York comprising 90% of the market. Losses were assumed to be covered in direct proportion to each insurer's statewide market share for New York workers' compensation and in proportion to countrywide percentage writings excluding New York workers' compensation. Loss amounts unrelated to New York workers' compensation were modeled to determine TRIA coverage application, loss amount excess of the deductibles, and prorated New York workers' compensation losses. Only New York workers' compensation losses are included in the average annual losses and loss costs reported in the results section of this report.

Indicated loss costs were provided per employee and per $100 dollars of payroll, prior to adjustment for payroll limitation. These values are calculated as follows:

Loss Cost per Employee=

(Average Annual Loss)/(Statewide Total Insured Employees)

Loss Cost per $100 Payroll=

(Loss Cost per Employee)/(Statewide Average Annual Wage)*100[1]

Average annual losses and loss costs were calculated for the terrorism and earthquake perils separately on a gross basis. Average annual losses and loss costs will also be provided net of the current TRIA and both proposals in Congress for the terrorism perils. An adjustment for loss expenses was also included in each of these indications.

[1] A loss adjustment expense factor of 1.163 (Source: NYCIRB) was applied to the loss costs listed above to derive indicated loss cost and loss adjustment expenses.

# AIR Terrorism Model for the United States

## Terrorism Model Framework

The AIR Terrorism Model for the United States estimates property and casualty losses due to potential terrorist attacks. The model employs a 500,000-year catalog of simulated potential terrorism scenarios representing a complete probability distribution of losses, including those that may have no historical precedence. This process ensures that the full range of frequency and severity are well represented for this highly dynamic peril.

The modeling approach that is used for the AIR Terrorism Model uses the same basic structure developed by AIR for natural catastrophe loss estimation. A schematic of the framework for AIR's Terrorism Model is shown in Figure 1 below.


**Figure 1: AIR Terrorism Model Framework**

Where AIR's natural catastrophe models are based on decades of historical data, the AIR Terrorism Model incorporates the judgment of a team of experts – the "Red Team" – who are familiar with both the available historical data and current terror activity trends. Red Team experts have decades of experience in counterterrorism at the highest levels including the FBI, CIA, Department of Defense, and Department of Energy. The AIR Terrorism Model's **hazard component** incorporates the Red Team's detailed operational threat assessments to determine plausible event scenarios and their frequencies. Local intensity calculations for each simulated event take into account a wide variety of factors including the type of weapon that is used, the urban density at the location of the attack and the effect of weather conditions on biological and chemical agent dispersions.

The **engineering component** of the AIR Terrorism Model reflects the amount of damage for each simulated event. For terrorist attacks using conventional and nuclear weapons, buildings sustain damage as a result of a variety of assaults on their structural integrity and their non-structural components. For chemical and biological weapons, the structure of the building may be unaffected, but the resulting contamination may render it unusable for long periods of time and result in extensive cleanup costs. In all cases, AIR damage ratios determine loss to building and contents and loss due to downtime. When property destruction or contamination from a terrorist attack affects a workplace,

employees who are in or near the building at the time can sustain a wide variety of injuries, ranging from minor to fatal. Depending on the time of day the attack occurs, the number of people at work at the time, and other factors, a significant percentage of the total insured losses can be due to workers' compensation.

The **financial component** of the AIR Terrorism Model uses a comprehensive cost model to translate estimated damages into monetary losses. The loss calculation for workers' compensation' combines information on the number of employees at a location, injury rates, and the cost of injuries to generate the total loss distribution at a particular location.

## AIR Terror Target Database

The risk of attacks is considered for all metropolitan areas of the United States. AIR maintains a comprehensive target/landmark database whose extent across the country comprises approximately 300,000 potential targets with over 41,000 selected for the stochastic catalog. This includes over 100 "trophy targets" that carry the highest probability of an attack as deemed by the Red Team panel of experts. Terrorists tend to target major iconic cities with dense populations, such as New York City, where one attack can have the maximum possible impact in terms of both casualties and symbolism. Within New York state, the AIR terror target database includes approximately 8,400 potential targets with almost 3,600 selected for use in the stochastic catalog. The database also contains 28 trophy targets in New York state, including iconic landmarks such as Grand Central Station, the New York Stock Exchange, J.F.K. International Airport, and the Lincoln Tunnel, among others.

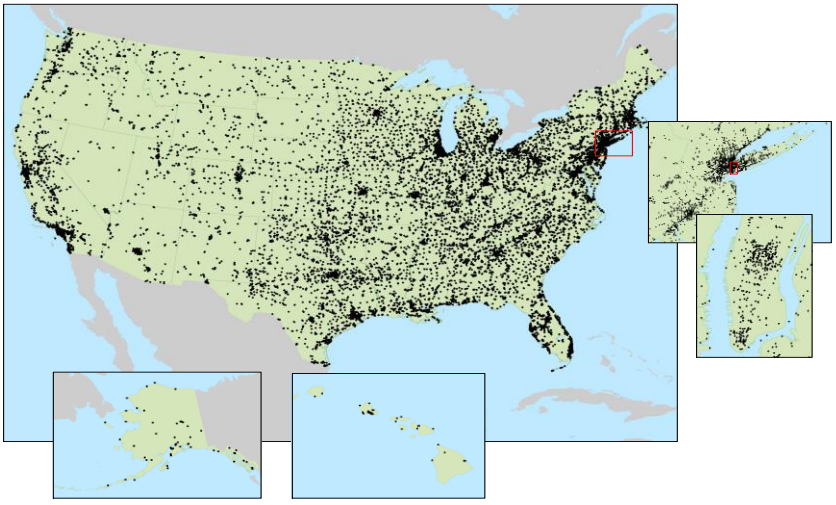

**Figure 2: AIR Terror Target Database Includes Potential Targets in All 50 States**

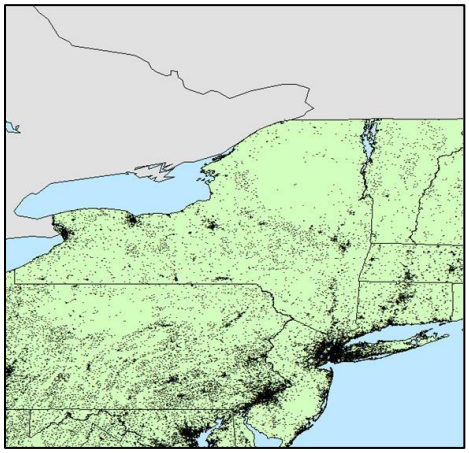

**Figure 3: AIR Terror Target Database for New York State**

## Modeled Weapon Types

AIR's Terrorism Model considers a comprehensive array of conventional and nonconventional weapon types. In the AIR model, conventional attack type weapons include bomb-blasts and airplane crashes. Nonconventional attacks, also known as CBRN, are defined as chemical, biological, radiological or nuclear weapon types.

**Table 1: Modeled Conventional Weapons**

| Weapon | Energy Equivalent (Ton – TNT) |
|---|---|
| Portable Bomb | 0.25 |
| Car Bomb | 0.75 |
| Van Bomb | 2.5 |
| Delivery Truck Bomb | 6 |
| Large Truck Bomb | 25 |
| Small Plane Crash | 0.5 |
| Large Plane Crash | Equivalent to large commercial jet |

**Table 2: Modeled Nonconventional (CBRN) Weapons**

| Weapon | Type | Size | Amount |
|---|---|---|---|
| Chemical | Sarin, VX | Small | Package (Several Grams) |
| | | Medium | 1 kg |
| | | Large | 100 kg |
| Biological | Anthrax, Smallpox | Small | Letter (a few grams) |
| | | Medium | 0.1 kg |
| | | Large | 1 kg |
| Radiological Dispersion (Dirty Bomb) | Cesium, Cobalt | Large | 1 kg |
| Nuclear Bomb | Nuclear Bomb | Small | 1 kiloton (TNT Equivalent) |
| | | Medium | 20 kilotons (TNT Equivalent) |
| | | Large | 50 kilotons (TNT Equivalent) |

## Modeling the Effects of Conventional Weapons

The damage functions used in the AIR model for conventional attacks determine the mean damage ratio for specified construction types and heights based on their distance from the blast, urban density, and the severity of the blast itself.

By taking the urban landscape into account, AIR engineers determined how the mean damage ratio changes with distance for each construction type. In a dense urban environment, the configuration and proximity of buildings introduces complex propagation paths, as illustrated in Figure 4 below.

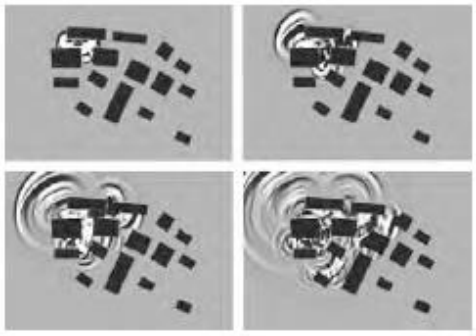

**Figure 4: Complexity of Reflected Pressure Waves in an Urban Environment (U.S. Army Engineer Research and Development Center)**

In general, the denser the environment, the more severe the damage will be to the target and buildings in the immediate vicinity of the blast. The highest urban densities in the United States are found along the Atlantic seaboard from Boston to Washington, D.C., as well as in other major cities such as Chicago, Miami, Los Angeles, and the San Francisco Bay area. Much of the Midwestern and mountain areas of the U.S. have a very low urban density. Figure 5 illustrates the urban density of the New York City metropolitan area with close-ups of the Lower and Midtown Manhattan areas and Brooklyn.

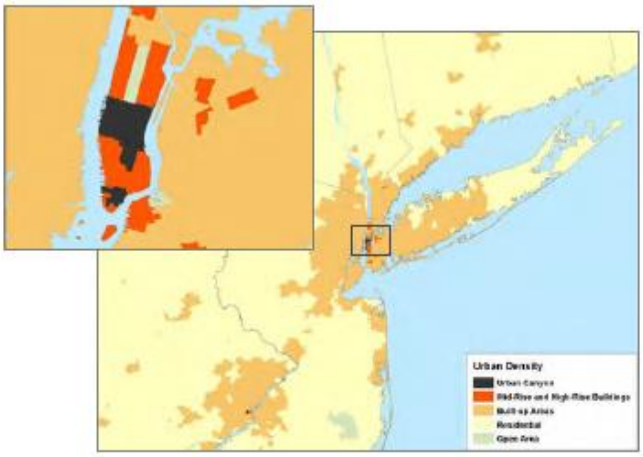


**Figure 5: Building Density in the New York Metropolitan Area**

Figure 6 illustrates the damage functions for a delivery truck bomb impacting a steel and reinforced concrete mid-rise building and for different urban densities. Notice that the damage is spread out farther in open areas than in densely built ones. In areas with a higher urban density, the damage is higher over a shorter distance, but falls more rapidly, eventually showing less damage over larger distances. This is due to the fact that shock waves are reflected off surrounding buildings in dense areas, which intensifies the damage but contains it to the area closest to the blast.

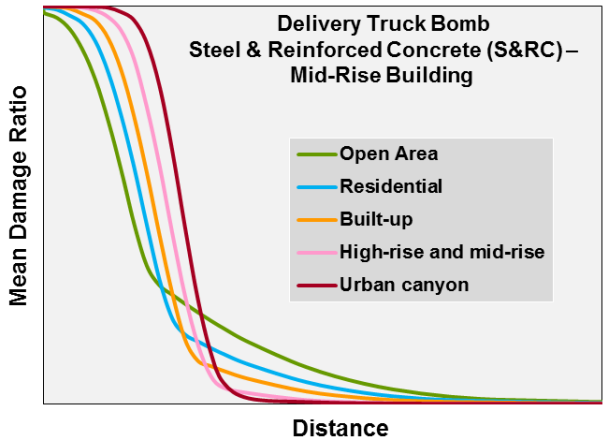


**Figure 6: Damage Functions for Different Urban Densities for Steel and Reinforced Concrete Buildings, 8-13 Stories, Delivery Truck Bomb (6 Ton-TNT)**

## Modeling the Effects of CBRN Weapons

The AIR Terrorism Model utilizes the Hazard Prediction and Assessment Capability (HPAC) model developed for the Defense Threat Reduction Agency (a unit of the Department of Defense) and the Federal Emergency Management Agency (FEMA). The HPAC model can simulate different attack types including the chemical agents Sarin and VX, and biological agents including anthrax and smallpox. It also includes capability for simulating various types of nuclear and radiological attacks using materials such as cesium, cobalt, and plutonium. The HPAC model follows a "source/transport/effects" approach for simulating how a hazard agent originates, how the agent disperses from the source to the target (people or facility), and finally the resulting physical and psychological effects of the agent on humans, as well as the environment. HPAC also provides the capacity for modeling wind speed and direction over complex terrain, and for forecasting weather, which is required for accurate hazard assessment in real-time locations and situations. As a result, the model provides credible estimates of agent dispersion from which estimates of property damage and casualties can then be developed. Figure 7 shows an example of HPAC-modeled probabilities from dispersed anthrax. The figure shows the population within each of the probabilities, with the dispersion shape determined by the environmental conditions that are likely to prevail at the modeled time of the attack.

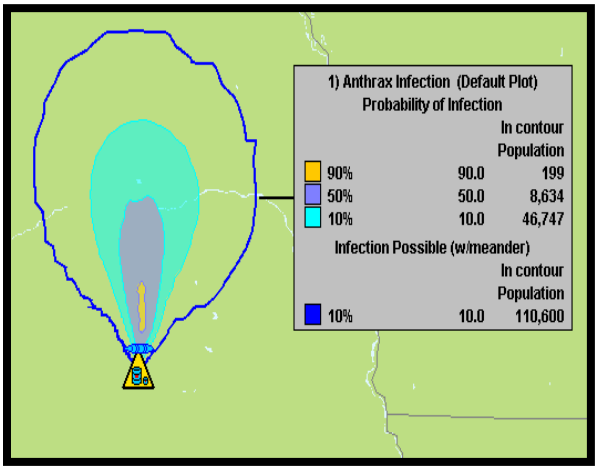


**Figure 7: Example of HPAC-modeled Infection Probabilities from Dispersed Anthrax**

## Estimating Injury Severity for Workers' Compensation

When property destruction or contamination from a terrorist attack affects a workplace, employees who are in or near the building at the time can sustain a wide variety of injuries, ranging from minor to fatal. Depending on the time of day the attack occurs, the number of people at work at the time, and other factors, a significant percentage of the insured losses can be due to workers' compensation.

The AIR model offers a complex analysis that incorporates the most likely types of injuries that are incurred in buildings of different construction types, with different levels of damage, along with a large number of other factors that affect workers' compensation losses. These include the injury severity rates, the construction type of the building, the nature of the damage sustained by the building, the number of workers who are at risk at the time of the attack, and loss of income due to attack-related injuries.

In the AIR model, the number of injuries and deaths, as well as the severity of injuries that result from conventional weapons, is a function of the severity and nature of the damage sustained by both structural and non-structural components of buildings and their contents. The blast wave creates missiles of airborne debris while, subsequent to the initial pressure wave, collapsing building elements can bring about blunt-force trauma. The AIR model employs a four-tier severity scale in accordance with HAZUS (see section: *Mapping Workers' Compensation Injury Type Severities to HAZUS Injury Severities*). To establish a relationship between injury rates and building damage, AIR developed probability distributions to determine the most likely level of damage to a building in the event of a conventional weapon attack. These distributions are mapped to different building damage states, namely, slight, moderate, extensive, and complete, as shown in Figure 8 below.

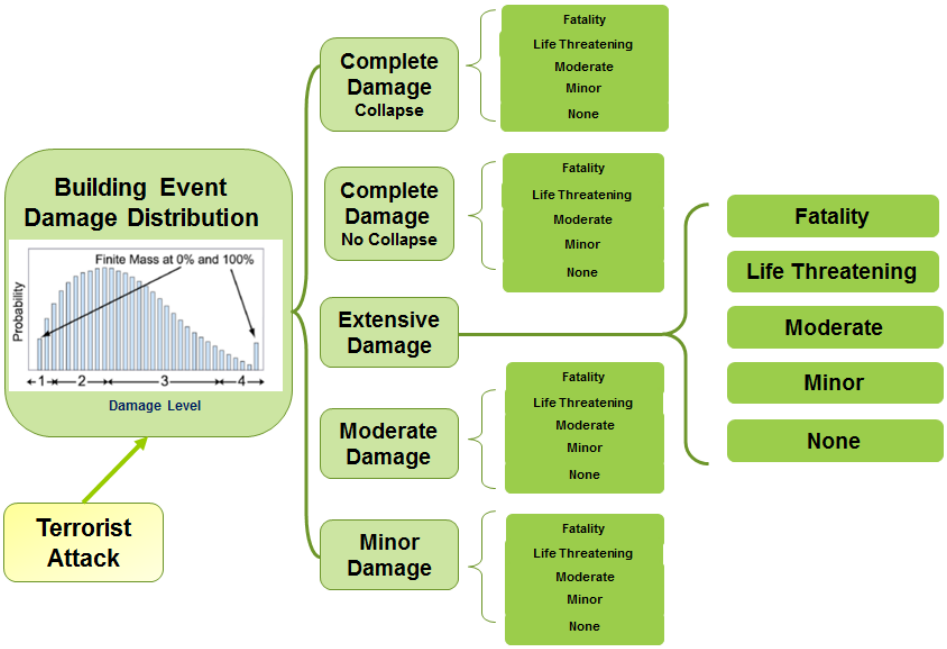


**Figure 8: Injury Severity Level by Building Damage State**

For CBRN attacks, the number and severity of injuries is calculated directly from the HPAC model output, which includes various types of "footprints" overlaid upon geo-referenced maps. Footprints include agent dosage, agent concentration, and the probability of mortality.

In the case of biological and chemical weapons, varying levels of disability are defined in addition to lethality. For nuclear and radiological weapons, the injury rates for nuclear and radiological attacks include the effects of radiation.

HPAC provides lethality rates corresponding to contours of blast and radiation exposure levels. Each one of these measures is translated to the injury classifications used by HAZUS.

## Estimating Workers' Compensation Terrorism Losses

The loss calculation for workers' compensation combines information on the number of employees at a location, injury rates, and the cost of injuries to generate the total loss distribution at a particular location. Figure 9 illustrates the flow of calculations after the injury severity-rate distributions are determined. Losses are calculated based on the number of employees in each injury severity.

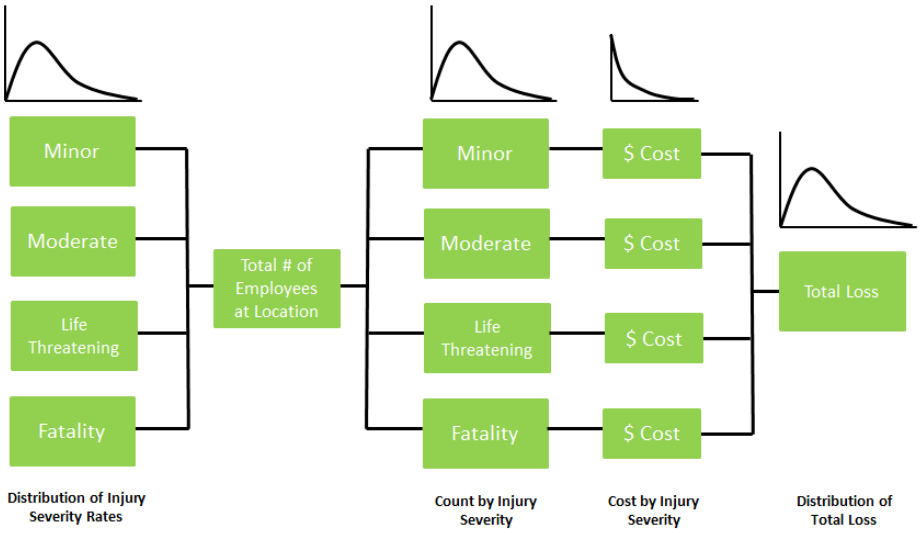


**Figure 9: Calculation of Workers' Compensation Loss for an Individual Location**

The model assumes that the number of employees present at a location is time-of-day and day-of-week dependent. That is, the AIR model assumes the percentage of workers in the workplace (rather than at home) depends on whether the attack occurs during a weekday or weekend, and whether it occurs during daytime working hours. The model's default assumptions about workplace occupancy are derived from the Federal Emergency Management Agency (FEMA) and the model assumes that terrorist attacks occur during daytime hours (9:00 a.m. to 4:59 p.m.). The model's default occupancy rates are shown in Table 3 below.

**Table 3: Default Model Assumptions about Workplace Occupancy**

| Occupancy Category | Night (7:00 p.m. - 6:59 a.m.) | Day (9:00 a.m. - 4:59 p.m.) | Commute (7:00 a.m. - 8:59 a.m., 5 p.m. - 6:59 p.m.) |
|---|---|---|---|
| Commercial | 0.02 | 0.98 | 0.5 |
| Industrial | 0.1 | 0.8 | 0.5 |
| Others (Includes Unknown) | 0.02 | 0.98 | 0.5 |

# AIR Earthquake Model for the United States

## Introduction to Earthquakes

An earthquake is the rapid relative displacement of the rock on either side of a fracture, or fault, in the interior of the solid earth. The energy released by a sudden slip along a fault plane produces seismic waves that radiate outward in all directions from the initial point of rupture and that cause the ground to shake at the earth's surface. Surface ground motion can range from barely perceptible trembling to violent shaking.

The geological understanding of earthquakes was revolutionized in the second half of the twentieth century by the theory of plate tectonics. In broad terms, the theory describes the earth's lithosphere — which extends from the earth's surface down to approximately 100-200 kilometers — as consisting of several large and fairly stable slabs of rigid rock called plates. These plates are in motion relative to each other above the asthenosphere — the underlying region of hotter and less rigid materials. Over time the asthenosphere materials behave as a viscous fluid, transferring heat from the interior to the surface of the earth. This convection of materials in the asthenosphere causes the plates of the lithosphere to move. Plates come into contact with each other at their edges, leading to enormous tectonic forces that cause physical deformation of the earth's surface. Most of the earth's seismic energy is released at these plate boundaries.

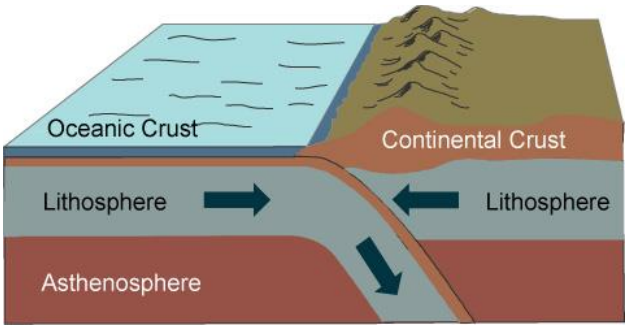


**Figure 10: The Earth's Layers as a Subduction Zone (Source: AIR)**

While some faults rupture the surface of the earth creating visible scars such as the San Andreas Fault in California and the ones caused by the 1995 Southern Hyogo Prefecture earthquake in Japan, many do not rupture the surface and can only be identified through their seismic activity or by using subsurface sounding techniques. Still other faults are only inferred from historical seismicity and it is likely that other, as yet unknown, faults exist throughout the world.

While the majority of earthquakes occur where plate boundaries converge, they also can occur within the interior of plates. Geologists believe that such areas are characterized by traces of ancient geological deformations or by variations in temperature and strength of the lithosphere. Earthquakes that occur in such areas are referred to as "intraplate" earthquakes. Examples of areas where intraplate earthquakes are a hazard in the United States include the New Madrid Seismic Zone in the central United States, the Intermountain Region of the western United States, and the Northeast.

## Measuring Earthquake Severity

The severity of an earthquake can be measured in a variety of ways. An earthquake's magnitude represents earthquake strength in terms of maximum ground motion, energy released, or other measures of the amplitude of the seismic wave of the earthquake. Several measures of earthquake magnitude have been defined, among them: moment magnitude, or "$M_w$," Richter magnitude, or "ML," body wave magnitude, or "$M_b$," and surface wave magnitude, or "$M_s$." Moment magnitude is a widely used measure and is uniformly applicable to all sizes of earthquakes in all locations.

Earthquake intensity, on the other hand, represents the earthquake's potential for damaging the infrastructure, as well as residential, commercial, and industrial structures, at the location of such structures. An earthquake will have one unique magnitude of a particular type, but its intensity is dependent upon the location at which the observations are being made, and will vary according to distance from the rupture, local soil conditions, local construction, and other factors.

## Earthquake Modeling and Loss Estimation

The AIR earthquake modeling technology uses stochastic modeling techniques to estimate the probability distribution of losses resulting from earthquakes. The earthquake occurrence module uses simulation techniques to generate a synthetic catalog of earthquake events that is generally consistent with the historical record and other geological and paleoseismic information. The shake damage module uses numerical techniques to calculate the distribution of losses for typical buildings of different kinds and portfolios of buildings, given the characteristics of each simulated event. Together, these techniques allow AIR to estimate a wide range of information about potential earthquake losses in the United States.

Data from various sources were analyzed and synthesized in the development of the AIR Earthquake Model for the United States and Canada.

### *Data Sources*

Data on historical earthquakes is relied upon for modeling earthquake characteristics. Historical earthquake catalogs may include events from hundreds or perhaps thousands of years ago. The

consistency of reporting, however, varies by magnitude. Data on large magnitude events are usually complete for longer time periods because they are more likely to have been noticed and documented. On the other hand, the sensitivity to and recording of smaller earthquakes has improved significantly during the twentieth century through the introduction of better and more extensive instrumentation. The completeness of the historical catalogs, therefore, is a function of time and magnitude, since larger earthquakes are more likely to be included earlier in the historical record. One of the primary tasks of AIR seismologists is to test each of the available historical catalogs for statistical completeness. Only the complete portions of the catalog for each magnitude range is used for statistical modeling in order to prevent bias in parameter estimates.

For the U.S. component of the AIR U.S. and Canada Earthquake Model, the most important data source is the United States Geological Survey (USGS).

## Seismicity Components of the AIR Earthquake Models

Depending on the region and the extent of scientific knowledge about the seismicity in the region, seismic sources are modeled as a combination of faults, area sources, and/or gridded background seismicity. Seismicity in the Central and Eastern United States, including New York, are described below.

### *Central and Eastern United States Seismicity*

The source of seismicity in the intraplate regions of the central and eastern United States is less well understood than that of the western United States. Scientists believe that these areas are characterized by traces of ancient geological deformations. For example, scientists define the New Madrid Seismic Zone, an area of significant seismic activity in the central United States, as that region coincident with the Reelfoot Rift, a relic from the Precambrian Era representing the failed attempt, more than 600 million years ago, of the North American plate to split apart.

The modeling methodology implemented for the central and eastern United States generally follows the framework embodied in the Documentation for the 2008 Update of the National Seismic Hazard Maps: USGS Open-File Report 2008-1128.

There is very little surface expression of causative faults in the region. The locations of faults can therefore only be inferred from recorded historical seismicity. The USGS identifies four fault sources in the central and eastern United States. In estimating the return times and magnitudes for characteristic events for fault sources in the central and eastern United States, scientists rely on auxiliary data, including evidence from exhumed liquefaction sites left by prehistoric earthquakes ("**paleoliquefaction**"). Assigning magnitudes to prehistoric events requires locating contemporaneous paleoliquefaction sites, estimating the total liquefied area, and converting this area to a magnitude.

USGS estimates of the magnitude of these events have been incorporated into the AIR U.S. Earthquake Model's continental U.S. component.

Apart from fault sources in the central and eastern United States, smoothed gridded seismicity is employed to account for the potential for earthquakes to occur in locations other than on known faults. In addition, several special source zones are defined based on variations in catalog completeness, maximum magnitude, and b-value. These include the New Madrid Seismic Zone surrounding the fault sources discussed above, the nearby Wabash Valley Seismic Zone; Charleston, South Carolina; east Tennessee; and the Charlevoix zone in eastern Canada. For each, simulated earthquakes are generated from truncated GR distributions, the parameters of which are zone-specific.

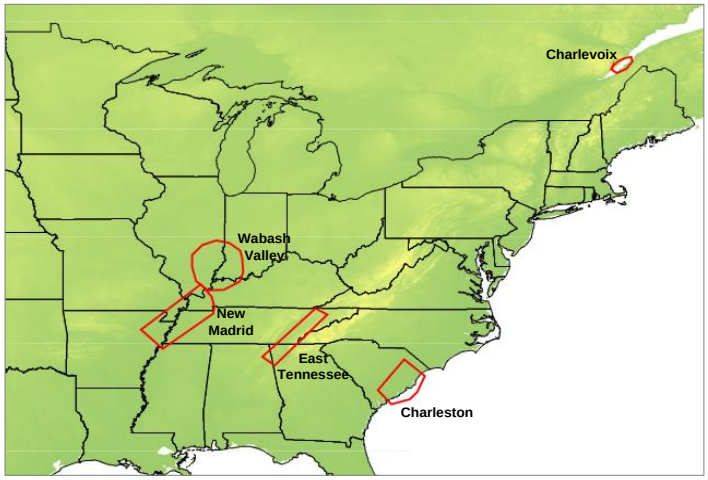


**Figure 11: Special Seismic Zones in the Central and Eastern United States**

Four uniform background zones are defined based on geologic and seismic characteristics to allow future earthquakes to occur where there has been little or no historical seismicity.

**Measuring Background Seismicity**: In order to deliver catalogs that are both accurate and computationally efficient, an optimization process has been implemented to obtain a representative extraction from the 1M catalog of 100,000 years (10 times smaller) that minimizes sampling variability (the error that appears in the statistical characteristics of a sample when its size is reduced).

This process consists of a multi-criteria optimization procedure in which three aspects of the catalog are evaluated: the magnitude-rate distributions for each region in the US, the ground motion at specific locations and at specific return periods, and the loss distributions. Maintaining these three main traits of the one million year sample in a smaller 100,000-year sample is a complex endeavor that AIR solves using advanced evolutionary computation techniques.

New York Earthquake Risk

Earthquake risk in New York is moderate, considering population density, infrastructure, and building stock. In the AIR Earthquake Model for the United States and Canada, earthquake risk in New York is modeled as background seismicity. Recorded historical earthquakes with epicenters near New York City include a magnitude 5.2 earthquake in 1737 and a second magnitude 5.2 earthquake in 1884.

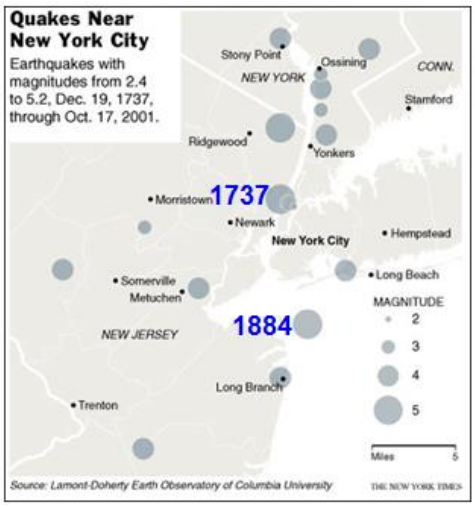


**Figure 12: Historical Earthquakes near New York City**

# Exposure Information and Assumptions

## Industry Exposure Database

AIR has developed databases of estimated numbers, types and values of properties for various lines of business in all regions of the world for which it develops models. These databases have been constructed from a wide range of data sources and reflect the estimated total replacement cost of property exposures. They are used to estimate total insured property losses. In the Unites States, the AIR Industry Exposure Database also includes estimates of the number of employees and shift percentages that are used to estimate total workers compensation losses. Insured loss estimates are based on assumptions as to the level of deductibles and proportion of total properties and number of employees insured. Estimates are provided at a very granular geographical level. Assumptions specifically regarding insurance policies and trends are based on insurance industry sources, including clients, industry organizations and government studies. Insured industry loss estimates are derived from the insurable industry through the application of area- and peril-specific insurance take-up rates. The workers' compensation take up rate assumptions used in this analysis are from the National Academy of Social Insurance (NASI) as of 2014.

AIR's U.S. Industry Exposure Database is developed using information from a diverse set of public and private data sources. Data sources include the U.S. Census Bureau, Dun & Bradstreet, Nielsen, Claritas, ISO, the Insurance Information Institute, and R.S. Means.

The Industry Exposure Database for New York represents over 225,000 commercially occupied structures and over 9.5 million employees. For purposes of modeling we applied a 69% take up rate to arrive at 6.6 million insured employees.

# Workers' Compensation Severity Assumptions

## Average On-level Costs by Injury Type Developed to Ultimate

The NYCIRB provided AIR with average claim costs for the standard six injury types by policy year: fatalities (FT), permanent total injuries (PT), major permanent partial injuries (PPmajor), minor permanent partial injuries (PPminor), temporary total injuries (TT), and medical only (MO). Average severities were provided for policy years 2001 through 2011. These average costs were as of the reported policy years developed to tenth report. In addition, the NYCIRB provided on level benefit factors and 10th to ultimate loss development factors. With this information, AIR developed average costs for each policy year and injury type that reflected developed losses to ultimate valuation.

## Mapping Workers' Compensation Injury Type Severities to HAZUS Injury Severities

The AIR Terrorism and Earthquake models produce Workers' Compensation injury rates by severity level for each defined HAZUS (FEMA) categories[2]: minor, moderate, major, and fatalities. In order to calculate workers' compensations losses for each modeled event, therefore, expected workers' compensation severities must be estimated separately for each of these. New York statewide workers' compensation losses by reported NYCIRB injury type were then mapped to the appropriate HAZUS injury classifications. The mapping percentages by type and HAZUS definitions are listed in the table below[3].

[2] HAZUS injury rates are determined in accordance with the structural damage or contamination ratio resulting from catastrophic occurrences.
[3] The entire distribution of statewide severities by WC injury type was mapped into the four HAZUS injury categories.

**Table 4: HAZUS Definitions to Injury Type Mapping**

| NCCI Injury Type | HAZUS Severity Type | HAZUS Description |
|---|---|---|
| Fatalities (FT) | Fatalities 100% | Instantaneous death or mortal injury |
| Permanent Total (PT)<br><br>Permanent Partial (PPmajor) | Life Threatening<br><br>*WC Injury Type Mapping:*<br>PT 50%<br>PPmajor 50% | Injuries pose an immediate life-threatening condition if they are not treated expeditiously. Examples include: uncontrolled bleeding, internal injuries such as punctured organs, spinal injuries, and crush syndrome |
| Permanent Partial (PPmajor)<br><br>Permanent Partial (PPminor)<br><br><br>Temporary Total (TT) | Moderate Injury<br><br>*WC Injury Type Mapping:*<br>PPmajor 88%<br>PPminor 6%<br>TT 6% | A greater degree of medical care is necessary than in the case of minor injuries. The use of medical technology such as x-rays or surgery is needed, but the injury is not life-threatening. |
| Medical Only (MO) 100% | Minor Injury<br>MO 100% | Basic medical aid that can be administered by professionals is sufficient |

## Trending Ultimate, On-level Severities to Policy Year 2015

On level, ultimate losses were trended using several different methods, including:

1. Fitting an exponential regression separately to total indemnity and total medical on-level, ultimate average cost to the latest five and six policy years of experience. The average severities by injury type and type of loss, indemnity versus medical, were then trended to policy year 2015 using the indicated trends and averaged. Resulting policy year 2015 estimated average costs by standard workers' compensation injury type were then mapped to HAZUS injury type definitions.
2. Trending the most recent five and six years of policy experience using the medical and indemnity trend selections from the NYCIRB 2014 Loss Cost Filing. Results were then averaged and mapped from the standard injury definitions to HAZUS injury type.
3. Fitting an exponential regression to total (indemnity and medical combined) workers' compensation average, on-level ultimate losses after mapping WC injury types to HAZUS categories. This analysis was performed separately using five and six years of experience before averaging the indications.
4. Trending combined medical and indemnity losses after mapping to HAZUS injury types using the total loss trend selection from the NYCIRB 2014 Loss Cost Filing then averaging.

## Selection of On-level, Ultimate Policy Year 2015 Severities by HAZUS Category Prior to Catastrophe Adjustment

The NYCIRB and AIR agreed to the estimates of policy year severities prior to the application of a catastrophe factor based on the following considerations:

- The selected values were in the middle of the range of the indications resulting from the methods described above.
- The inclusion of six years of policy experience resulted in more credible indications, in particular for fatal and life threatening injuries. Consequently, six year averages of on- level, ultimate policy year 2015 estimates were selected.
- The weighted trend selected by the NYCIRB in their most recent filing was virtually identical to that resulting from the five year exponential regression result based on combined losses after HAZUS mapping at 4.2 versus 4.4 percent, respectively.
- The five year fitted regression results were viewed as more reasonable and responsive than those resulting from six year fits.

The selected cost estimates resulted from combining on-level medical and indemnity losses and mapping WC injury types to HAZUS definitions, then applying the weighted average total trend based on the most recent NYCIRB filing of 4.2% and, finally, averaging the most recent six years of policy severity experience by HAZUS injury type.

## Catastrophe Adjustment

Workers' compensation average injury severities are expected to differ from non-catastrophic severities for various reasons. First, certain types of injuries are not likely to result from a catastrophic occurrence, and these include but are not limited to repetitive motion claims. In addition, injuries sustained as a result of a catastrophic occurrence may be expected to have a higher stress related impact on average severities. Finally, in terrorism related incidents, workers with higher than average wages may be more likely to work in locales that are targeted.

The NYCIRB provided AIR with 9/11 claims severity data by injury type as of 10th report. This data was compared to average statewide severities for policy year 2001 after mapping to HAZUS injury type. Both sets of data were evaluated as of tenth report. The resulting ratios of 9/11 severities to statewide severities by injury type are listed below:

**Table 5: Ratios of 9/11 Severities to Statewide Average Severities by Injury Type**

| Fatalities | Life Threatening | Moderate Injuries | Minor Injuries |
|---|---|---|---|
| 1.20 | .90 | 1.71 | 4.79 |

AIR also examined the relativities of non-repetitive motion statewide severities to total statewide severities based on data publicly available on the California Workers' Compensation Rating Bureau website. The ratio for the 2011 policy was 1.06. AIR and the NYCIRB agreed to apply a catastrophe adjustment factor of 1.1 to average severities for all injury types for both the earthquake and terrorism perils. The final selected severities are listed in the table below.

**Table 6: Severities Used for Modeling Loss**

| Minor Severity | Moderate Severity | Major Severity | Fatality |
|---|---|---|---|
| $1,505 | $252,476 | $1,435,372 | $865,800 |

# Terrorism Risk Insurance Act (TRIA)

## TRIA Background

The Terrorism Risk Insurance Act (TRIA) was first established in 2002 to create a public-private risk-sharing agreement between the federal government, the insurance industry, and commercial policyholders. It was enacted as a response to economic fears resulting from the tragic events of September 11, 2001. The most recent extension of the TRIA program was enacted in 2007 under the Terrorism Risk Insurance Program Reauthorization Act (TRIPRA). In the absence of Congressional action, TRIPRA is due to expire on December 31, 2014. While the future of the TRIA program is still very uncertain at this time, both the Senate and the House of Representatives are currently working on measures to reauthorize the program. Senate bill S.2244, which was passed by the Senate Banking Committee in June 2014 and by the full Senate in July, proposes to renew the TRIA program for another seven years. The House bill, H.R. 4871, passed by the House Financial Services Committee in June 2014, proposes to renew TRIA for five years. Both measures propose a reduced federal role in the TRIA program.

The table below outlines at a high level the current application of TRIPRA as well as the Senate and House reauthorization bills.

**Table 7: Application of Terrorism Risk Insurance Act**

| | TRIPRA | Senate Bill S.2244 (2016 Program Year) | House Bill H.R. 4871 (2016 Program Year) |
|---|---|---|---|
| Program Length | Expires Dec 31, 2014 | 7 years | 5 years |
| Minimum Damage Certification Level | $5 million | $5 million | none |
| Program Trigger | $100 million | $100 million | $100 million CBRN<br>$200 million conventional |
| Insurer Deductible | 20% Direct Earned Premium | 20% Direct Earned Premium | 20% Direct Earned Premium |
| Insurer Loss Share | 15% | 16% | 15% for CBRN, 16% for conventional weapons |
| Cap on Annual Aggregate Liability | $100 billion | $100 billion | $100 billion |

## Modeling TRIPRA

The current design of TRIA, known as TRIPRA, will be in effect until December 31, 2014. For modeling recoveries in conjunction with a stochastic terror attack loss simulation process, we first considered the TRIPRA 2014 program year. It is important to note that the actual insurer recoveries expected under TRIPRA are largely dependent on the insurers that are ultimately impacted by a terror attack event. For example, the size of the insurer deductible and federal loss share will differ according to the number and relative size of insurers impacted by the event. Therefore, it is necessary to make certain reasonable assumptions to model the expected insurer recoveries under the program.

### *Determining TRIPRA Eligible Events*

Coverage under the TRIPRA program begins after the eligible modeled annual aggregate terror attack losses exceed the program trigger, $100 million, in any simulated event year. There will be no coverage under TRIPRA for modeled annual aggregate terror attack losses that exceed the annual program liability cap of $100 billion. Additionally, for any modeled terror attack loss occurrence that is less than $5 million, there will be no insurer recovery, according to the minimum damage certification level under TRIPRA.

To determine total event loss, as well as annual aggregate loss, commercial property and workers' compensation terrorism losses were modeled for the entire United States using AIR's aggregate modeling software, CATRADER®, which is comprised of modeled insured loss estimates for the insurance industry. These losses were combined with the location specific New York workers' compensation modeled losses.

### *Calculating the TRIPRA Insurer Deductible*

The largest 15 writers of workers' compensation insurance in New York, which account for 90% of workers' compensation direct premiums written in New York, were assumed to represent the New York workers' compensation market.

Direct written premiums provided by the NYCIRB were used to determine New York workers' compensation market share. A.M. Best 2013 direct earned premium (DEP) data for TRIA eligible lines of business was used to calculate market shares for commercial property in New York and all TRIA eligible lines of business outside of New York.

The TRIPRA deductible for the each of the top 15 New York workers' compensation writers was calculated as 20% of TRIA eligible lines DEP. The remaining companies, which make up 10% of the New York workers' compensation market, were assigned an average deductible and market share percentage based on the largest fifteen writers.

### *Application of the TRIPRA Deductible*

The assumption was made that the top 15 workers' compensation writers are impacted for each modeled terror attack event simulation in proportion to their market share. New York workers' compensation market share was applied to New York workers' compensation loss. All other countrywide TRIA eligible lines market share was used for all other terrorism losses. The insurer deductibles were applied annually to the fraction of the loss covered by each insurer.

### *Calculation of Loss above TRIPRA Deductible*

The insured loss shared compensation assumes that the federal share of loss is 85% of insured losses that exceed the insurer deductible. The insurer is responsible for the other 15% of the insured losses that exceed the insurer deductible. Individual insurer net loss was calculated for each simulation year to determine individual insurer net loss. Aggregate losses to the insurers and the federal government are limited by the annual program liability cap of $100 billion.

### *Calculation of Net Loss*

Net loss for the state of New York is the sum of the largest 15 insurers' net loss, divided by 90%.

#### *Example of TRIPRA Application*

The following case study outlines the process for applying TRIPRA to modeled terrorism loss for a sample year in which the following events occurred:

- Event 1: A terrorist event that causes $2 billion in workers' compensation loss in the state of New York.
- Event 2: A terrorist event that causes $4 billion in commercial property and workers' compensation loss in California.

Both events in this year have loss levels that exceed the $5 million minimum damage certification level. The aggregate loss for the year, $6 billion, exceeds the program trigger of $100 million.

Since the first two requirements are met, event losses were assigned to each of the top 15 New York Workers' Compensation writers. A sample Insurer, Insurer 1, has 6.6% market share for TRIA eligible lines countrywide, a 7.7% market share for New York Workers' Compensation, and a TRIPRA deductible of $2.6 billion.

Insurer 1 experiences $154 million in loss from the New York event, and $264 million in loss from the California event, for a total annual loss of $418 million. This is less than the insurer deductible of $2.6 billion, so is not covered by TRIPRA. New York workers' compensation net loss for Insurer 1 is equal to New York workers' compensation gross loss, $154 million.

This same process is completed for each of the 15 insurers. Total Net Loss for the year is the sum of insurer net loss divided by 90% to reflect the entire market.

Average annual loss is calculated by completing this process for each loss causing year, and dividing by the number of simulation years, in this case 500,000.

## Modeling Senate Bill, S.2244

Expected insurer recoveries were modeled under Senate bill S.2244 for the 2016 program year, according to the language contained in this bill as of the date of this report.

It is again important to note that the actual insurer recoveries expected under TRIA are dependent on the insurers that are ultimately be impacted by a terror attack event.

### *Determining Eligible Events*

The process used to determine eligible events under TRIPRA was replicated when modeling the Senate Bill.

### *Calculating the Insurer Deductible*

The process used for calculation of the insurer deductible under the Senate Bill is the same as the process used for the current TRIPRA program.

### *Application of the Deductible*

Our process for application of the insurer deductible under the Senate Bill is the same as the application of the insurer deductible for the current TRIPRA program.

### *Calculation of Loss above the Deductible*

For the 2016 program year, the insured loss shared compensation assumes that the federal share is 84% of insured losses that exceed the insurer deductible. The insurer is responsible for 16% of the insured losses that exceed the insurer deductible. Losses to the insurers and the federal government are limited by the annual aggregate program liability cap of $100 billion. The process implemented for modeling TRIPRA was replicated, only increasing the insurer loss share above the deductible from 15% to 16%.

### *Calculation of Net Loss*

The process used for calculation of the insurer deductible under the Senate Bill is the same as the process used for the current TRIPRA program.

## Modeling House Bill, H.R. 4871

Expected insurer recoveries were modeled under House of Representatives bill H.R. 4871 for the 2016 program year, according to the language contained in this bill as of the date of this report. The House bill includes an additional level of complexity, by accounting for the weapon type – CBRN versus Conventional – in the determination of eligible events and calculation of the insurer loss share.

It is again important to note that the actual insurer recoveries expected under TRIA are largely dependent on the insurers that are ultimately be impacted by a terror attack event.

### *Determining Eligible Events*

Coverage under the House Bill begins after the eligible modeled annual aggregate terror attack losses exceed the program trigger, $100 million for CBRN events and $200 million for conventional weapon events, in any simulated event year. There will be no coverage for modeled annual aggregate terror attack losses that exceed the annual program liability cap of $100 billion. The House Bill eliminates TRIPRA's minimum damage certification level of $5 million.

To determine total event loss, as well as annual aggregate loss, commercial property and workers' compensation terrorism losses were modeled for the entire United States.

### *Calculating the Insurer Deductible*

The process used for calculation of the insurer deductible under the House Bill is the same as the process used for the current TRIPRA program.

### *Application of the Deductible*

We assumed that the top 15 workers' compensation writers are impacted for each modeled terror attack event simulation in proportion to their market share. New York workers' compensation market share was applied to New York workers' compensation loss. All other countrywide TRIA eligible lines market share was used for all other terrorism losses. If total company loss from terrorism events exceeded the company deductible, then the deductible was applied separately to losses from CBRN attacks and conventional attacks in the simulated year.

### *Calculation of Loss above the Deductible*

For the 2016 program year, the insured loss shared compensation assumes that the federal share is 85% of insured losses that exceed the insurer deductible for CBRN attacks and 84% of insured losses that exceeds the insurer deductible for conventional attacks. The insurer is responsible for 15% and 16% of the insured losses that exceed the insurer deductible for CBRN and conventional attacks, respectively. These loss percentages were applied to annual losses above the insurer deductible for CBRN and

conventional attacks separately. Individual insurer net loss is the sum of conventional and CBRN net loss. Aggregate losses to the insurers and the federal government are limited by the annual program liability cap of $100 billion.

### *Calculation of Total Net Loss*

The process used for calculation of the insurer deductible under the House Bill is the same as the process used for the current TRIPRA program.

# Results

AIR estimated gross losses and loss adjustment expenses (and corresponding loss costs) separately for the terrorism and earthquake perils. In addition, losses and loss adjustment expenses were estimated net of the current TRIA federal reinsurance program (TRIPRA) for the terrorism peril along with estimates of the potential impact of the Senate and House TRIA reauthorization bills. A brief overview of the process used to arrive at these estimates is as follows:

- Workers compensation losses were modeled separately for the earthquake and terrorism perils using Touchstone at the location level. The AIR Industry Exposure Database (IED) was used to estimate exposures. New York state workers compensation average severities were, for each of the HAZUS severities, estimated using the most recently reported policy year experience to the NYCIRB.
- Terrorism and earthquake losses were simulated for 500,000 and 100,000 years, respectively, in Touchstone. Average annual gross losses were determined by adding the losses for each simulated event and dividing by the number of years modeled for each peril.
- For the terrorism peril, losses were modeled net of the current TRIA program. Net loss estimates were also provided for the current House and Senate bills, H.R. 4871 and S.2244.
- Losses net of TRIA were estimated by modeling the impact of TRIA on the largest fifteen writers of workers' compensation in New York. Workers compensation losses in other states and commercial property losses were modeled using our aggregate modeling software, CATRADER, to determine TRIA eligibility and coverage triggers as well as for deductible and pro rata allocation purposes.
- Loss adjustment expenses were added to loss indications by applying a factor of 1.163 to gross and net loss indications. The loss adjustment factor was selected by the NYCIRB and is that proposed in their 2014 loss cost filing.
- Gross and net loss and loss adjustment expense indications were converted to loss (&LAE) costs on a per employee basis by dividing average annual losses by the number of estimated insured employees. Loss costs were estimated on a $100 of payroll basis as well.

## Average Annual Losses

- **Earthquake Gross: $1.98 million**
- **Terrorism Gross: $380.73 million**
- **Terrorism Net of TRIPRA: $150.44 million**
- **Terrorism Net of Senate Bill S.2244: $151.83 million**
- **Terrorism Net of House Bill H.R. 4871: $151.07 million**

Average annual losses are adjusted by a factor of 1.163 to account for loss adjustment expense below. The loss adjustment expense factor was provided by the NYCIRB.

## Average Annual Losses Including Loss Adjustment Expense

- **Earthquake Gross: $2.30 million**
- **Terrorism Gross: $442.79 million**
- **Terrorism Net of TRIPRA: $174.96 million**
- **Terrorism Net of Senate Bill S.2244: $176.58 million**
- **Terrorism Net of House Bill H.R. 4871: $175.69 million**

The average annual losses and loss adjustment expenses listed above for both the earthquake and terrorism losses on a gross basis and terrorism losses net of TRIPRA as well as the House and Senate reauthorization bills result in the following implied loss costs per employee assuming 6.6 million employees insured statewide.[4]

## Loss Cost and Loss Adjustment Expense per Employee:

- **Earthquake Gross: $0.34**
- **Terrorism Gross: $67.40**
- **Terrorism Net of TRIPRA: $26.63**
- **Terrorism Net of Senate Bill S.2244: $26.88**
- **Terrorism Net of House Bill H.R. 4871: $26.74**

[4] Sources: Nielson and the National Association of Social Insurance.

The loss costs including loss adjustment expenses per $100 dollars of payroll assuming an average annual wage of $63,075[5] for the state of New York prior to adjustment for limited payroll are:

## Loss Cost and Loss Adjustment Expense per $100 Payroll [6]

- **Earthquake Gross: $0.000543**
- **Terrorism Gross: $0.107**
- **Terrorism Net of TRIPRA: $0.042**
- **Terrorism Net of Senate Bill S.2244: $0.043**
- **Terrorism Net of House Bill H.R. 4871 : $0.04**

[5] Source: New York State Department of Labor Statistic 2013 average weekly wage for NY=$1,212.98
[6] Prior to adjustment for payroll limitation

# Conclusion

Expected annual workers' compensation terrorism losses constitute a significant economic risk for workers' compensation insurers and the employers they provide coverage for in the state of New York. The federal reinsurance provided under the current TRIPRA law significantly reduces insurer capacity requirements and provides savings to employers in the form of lower rates.

Reductions of approximately 60% in average annual losses and loss costs result from applying TRIPRA terms to gross indications, calculating losses net of current TRIPRA from gross or ground up indications.

The impact of the proposed changes to the current federal program, Senate Bill S.2244 and House Bill H.R.4871 is minor in comparison to the impact of not renewing TRIA in either its current form or as specified in either the House or Senate reauthorization bills[7]. However, if Congress fails to renew or makes significant changes to the federal government's current program, insurers in the state of New York may be significantly impacted.

[7] This analysis does not include the impact of proposed changes to the recoupment of federal shares by either Chamber of Congress.

## About AIR Worldwide Corporation

AIR Worldwide (AIR) is the scientific leader and most respected provider of risk modeling software and consulting services. AIR founded the catastrophe modeling industry in 1987 and today models the risk from natural catastrophes and terrorism in more than 90 countries. More than 400 insurance, reinsurance, financial, corporate, and government clients rely on AIR software and services for catastrophe risk management, insurance-linked securities, detailed site-specific wind and seismic engineering analyses, agricultural risk management, and property replacement-cost valuation. AIR is a member of the Verisk Insurance Solutions group at Verisk Analytics and is headquartered in Boston with additional offices in North America, Europe, and Asia. For more information, please visit www.air-worldwide.com.

Although AIR's simulation methodology is a superior technique for estimating potential losses, the methodology does have certain limitations. It is based on mathematical/statistical models that represent real-world systems. As with all models, these representations are not exact. The model relies on various assumptions, some of which are subject to uncertainty. Accordingly, the loss estimates generated by the model are themselves subject to uncertainty. The loss estimates and their associated probabilities are estimates of the magnitude of losses that may occur in the event of such natural hazards; they are not factual and do not predict future events. Actual loss experience can differ materially. The results are intended to function as one of several tools for use in analyzing estimated expected and potential losses from extreme events. The assumptions that AIR used in creating them may not constitute the exclusive set of reasonable assumptions and methodologies. The use of alternative assumptions and methodologies could yield materially different results.

# Catastrophe Loss Analysis Service

New York Terrorism Supplemental Report

Prepared for the New York Compensation Insurance Rating Board

December 12, 2014

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# Introduction

This report documents the results of AIR Worldwide's (AIR) supplemental Catastrophe Loss Analysis Service (CLAS™) for the New York Compensation Insurance Rating Board (NYCIRB). The supplemental analyses include estimates of New York state average annual workers' compensation losses, loss costs per employee and per $100 of payroll net of TRIA for the 2015, 2016 and 2017 program years. Estimated losses were calculated in accordance with the provisional terms of the Terrorism Risk Insurance Program Reauthorization Act of 2014, as noted in the House of Representatives TRIA bill amendment to Senate bill S.2244[1]. Modifications impacting our estimates of New York state average annual workers' compensation losses begin in 2016. Changes for program years 2016 and 2017 are expected to include:

1. The insured loss shared compensation assumes that the Federal Government shares are 84% and 83% of insured losses that exceed the insurer deductible, in 2016 and 2017 respectively. This means insurer is responsible for 16% of the insured losses that exceed the insurer deductible in 2016 and 17% in 2017.
2. Coverage under the most recently proposed Congressional Bill amendment begins after eligible modeled annual aggregate terror attack losses exceed a program trigger of $120 million for all event types, for calendar year 2016 and $140 million for calendar year 2017.

A brief outline of the Terrorism Risk Insurance Reauthorization Act of 2014 is provided below along with the 2015 through 2017 program year losses and loss costs as estimated in accordance with the legislation during this initial three year period.

We did not model changes in the law that are considered by AIR and the NYCIRB to be immaterial to the calculation of insurance losses and loss costs on a prospective basis. For instance, changes to mandatory recoupment fees are expected to impact insurers and policyholders on a retrospective basis. Therefore, this report does not address nor speak to the impact of these changes.

For an in depth discussion of the AIR Terrorism Model for the United States 500,000 year stochastic catalog, the AIR Worldwide industry exposure database including estimates of the number of employees at over 225,000 geographical locations in the state of New York and the average cost or severity estimates by injury type, please see the complete AIR CLAS Report for the NYCWIRB.

The assumptions underlying this analysis have remained consistent with those outlined in the initial report. Gross loss and loss cost estimates are unchanged for both the terrorism and earthquake perils.

[1] Summary of Amendments Submitted to the Rules Committee for S.2244 – Terrorism Risk Insurance Program Reauthorization Act of 2014: http://www.rules.house.gov/amendments/nea123129141224442444.pdf

# Terrorism Risk Insurance Act (TRIA)

## TRIA Background

The Terrorism Risk Insurance Act (TRIA) was first established in 2002 to create a public-private risk-sharing agreement between the Federal Government, the insurance industry, and commercial policyholders. It was enacted as a response to economic fears resulting from the tragic events of September 11, 2001. The current version of TRIA (TRIPRA) expires on December 31, 2014 but is expected to be reauthorized for an additional six years under the Terrorism Risk Insurance Program Reauthorization Act of 2014[2]. This most recent reauthorization is expected, therefore, to expire on December 31, 2020.

Table 1 below outlines at a high level the application of TRIA as TRIPRA 2014:

**Table 1: Application of Terrorism Risk Insurance Act**

| | Current TRIPRA= TRIPRA 2014 (2015 Program Year) | TRIPRA 2014 (2016 Program Year) | TRIPRA 2014 (2017 Program Year) |
|---|---|---|---|
| Minimum Damage Certification Level | $5 million | $5 million | $ 5 million |
| Program Trigger | $100 million | $120 million | $140 million |
| Insurer Deductible | 20% Direct Earned Premium | 20% Direct Earned Premium | 20% Direct Earned Premium |
| Insurer Loss Share | 15% | 16% | 17% |
| Cap on Annual Aggregate Liability | $100 billion | $100 billion | $100 billion |

## Modeling TRIPRA 2014

The current renewal of TRIA, known as TRIPRA 2014, will be in effect until December 31, 2020. When modeling recoveries in conjunction with a stochastic terror attack loss simulation process, we considered program years 2015, 2016 and 2017 independently. It is important to note that the actual insurer recoveries expected under TRIPRA are largely dependent on the insurers that are ultimately impacted by a terror attack event. For example, the size of the insurer deductible and Federal loss share will differ according to the number and relative size of insurers impacted by the event.

[2] TRIPRA 2014 has not been yet been enacted into law as of the date of this report. The House amended bill is now awaiting a vote by the Senate. If passed by the Senate, the bill will move to the President for signing into law. While not anticipated, further changes to the TRIA reauthorization legislation are possible.

Therefore, it is necessary to make certain reasonable assumptions to model the expected insurer recoveries under the program.

### *Determining TRIPRA Eligible Events*

Coverage under the TRIPRA program begins after the eligible modeled annual aggregate terror attack losses exceed the program trigger in any simulated event year.

i. The program trigger will remain at $100 million for all insured losses occurring in 2015
ii. The trigger will increase to $120 million for calendar year 2016
iii. $140 million for calendar year 2017
iv. $160 million for calendar year 2018
v. $180 million for calendar year 2019
vi. $200 million for calendar year 2020

There will be no coverage under TRIPRA 2014 for modeled annual aggregate terror attack losses that exceed the annual program liability cap of $100 billion. Additionally, for any modeled terror attack loss occurrence that is less than $5 million, there will be no insurer recovery, according to the minimum damage certification level under TRIPRA 2014. The cap and minimum damage certification levels will remain at $100 billion and $5 million respectively for the entirety of the reauthorization, through 12/31/2020.

As described in the full report, to determine total event loss, as well as annual aggregate loss, commercial property and workers' compensation terrorism losses were modeled for the entire United States using AIR's aggregate modeling software, CATRADER®, which is comprised of modeled insured loss estimates for the insurance industry. These losses were combined with the location specific New York workers' compensation modeled losses.

### *Calculating the TRIPRA Insurer Deductible*

The current TRIA deductible is 20% of each company's countrywide Direct Earned Premium for all TRIA eligible lines. The deductible percentage and definition are the same throughout the reauthorization period and equal to that under the current plan.

The New York State Workers Compensation market was modeled using the experience of the largest fifteen writers of workers'; compensation in the state. Countrywide AM Best 2013 Direct Earned premium data was used to determine the deductible amounts by company. The deductibles were applied on an annual basis to the estimated fraction of loss covered by each insurer for each event and summarized by year.

### *Calculation of Loss above TRIPRA 2014 Deductible*

Under the current TRIPRA 2007 statute, the insured loss shared compensation assumes that the Federal share of loss is 85% of insured losses that exceed the insurer deductible. The insurer is responsible for the other 15% of the insured losses that exceed the insurer deductible. TRIPRA 2014 retains the current percentages for calendar year 2015. Beginning in calendar year 2016, the Federal Government's share will decrease by one percent each year through calendar year 2020 at which point the Federal Government's share of insured losses will be at 80%. Consequently, each insurer's share of the loss amount excess of their deductible amount will be:

i. 15% in calendar year 2015
ii. 16% in calendar year 2016
iii. 17% in calendar year 2017
iv. 18 % in calendar year 2018
v. 19% in calendar year 2019
vi. 20% in calendar year 2020

## Results

AIR estimated net losses, loss adjustment expenses and corresponding loss costs to New York workers' compensation insurers under the proposed 2014 reauthorization. Corresponding calendar year average annual losses and loss costs per employee and $100 of payroll were estimated for 2016 and 2017 given the changes expected to be promulgated by the reauthorization legislation. Calendar year 2015 was not re-estimated as the parameters modeled are identical to those under the current TRIPRA 2007 program, set to expire on 12/31/2014. A brief overview of the process used to arrive at these estimates is as follows:

- Changes to the method from that described in our original report included setting the insurer share of losses in excess of the deductible to 16% and 17% for calendar years 2016 and 2017, respectively. The coverage trigger was increased from $100 million under the current program to $120 million and $140 million for calendar years 2016 and 2017, respectively.
- Loss adjustment expenses were added to loss indications by applying a factor of 1.163 to gross and net loss indications. The loss adjustment factor was selected by the NYCIRB and is that proposed in their 2014 loss cost filing.
- Gross and net loss and loss adjustment expense indications were converted to loss and LAE costs on a per employee basis by dividing average annual losses by the number of estimated insured employees. Loss costs were estimated on a $100 of payroll basis as well.

## Average Annual Losses and Loss Adjustment Expenses Calendar Year 2015

- **Terrorism Gross Average Annual Loss and Loss Adjustment Expense: $442.79 million**
- **Terrorism Average Annual Loss Net of TRIPRA 2014: $174.96 million**
- **Terrorism Gross Loss Cost & LAE per Employee: $67.40**
- **Terrorism Net of TRIPRA 2014 Loss Cost & LAE per Employee: $26.63**
- **Terrorism Gross Loss Cost & LAE per $100 Payroll: $0.107**
- **Terrorism Net of TRIPRA 2014 Loss Cost & LAE per $100 Payroll: $0.042**

## Average Annual Losses and Loss Adjustment Expenses Calendar Year 2016

- **Terrorism Gross Average Annual Loss and Loss Adjustment Expense: $442.79 million**
- **Terrorism Average Annual Loss Net of TRIPRA 2014: $176.58 million**
- **Terrorism Gross Loss Cost & LAE per Employee: $67.40**
- **Terrorism Net of TRIPRA 2014 Loss Cost & LAE per Employee: $26.88**
- **Terrorism Gross Loss Cost & LAE per $100 Payroll: $0.107**
- **Terrorism Net of TRIPRA 2014 Loss Cost & LAE per $100 Payroll: $0.043**

## Average Annual Losses and Loss Adjustment Expenses Calendar Year 2017

- **Terrorism Gross Average Annual Loss and Loss Adjustment Expense: $442.79 million**
- **Terrorism Average Annual Loss Net of TRIPRA 2014: $178.20 million**
- **Terrorism Gross Loss Cost & LAE per Employee: $67.40**
- **Terrorism Net of TRIPRA 2014 Loss Cost & LAE per Employee: $27.12**
- **Terrorism Gross Loss Cost & LAE per $100 Payroll: $0.107**
- **Terrorism Net of TRIPRA 2014 Loss Cost & LAE per $100 Payroll: $0.043**

## Conclusion

If passed, TRIPRA 2014 will reauthorize TRIA with minor changes to the existing program. AIR Worldwide estimates the impact of these changes on New York workers' compensation net losses and loss adjustment expenses at approximately a one percent increase per year for calendar years 2016 and 2017, respectively.

Increases in New York workers' compensation net losses and loss adjustment expenses are a result of the increase in the insurer sharing percentage of losses exceeding the individual insurer deductibles. The insurer sharing percentages are increasing to 16% in calendar year 2016 and subsequently to 17% in 2017. Changing the program trigger from $100 million to $140 million did not result in any change to the modeled New York workers' compensation loss cost estimates. In reality, potential losses due to terrorist attacks could differ for reasons previously outlined in the full AIR CLAS report for the NYCIRB. Among those, writers of very small percentages of New York Workers' Compensation Insurance (less than one percent) were not directly modeled in our study. We do not expect the potential losses to the small insurance writers to be significant on a statewide basis.

## About AIR Worldwide Corporation

AIR Worldwide (AIR) is the scientific leader and most respected provider of risk modeling software and consulting services. AIR founded the catastrophe modeling industry in 1987 and today models the risk from natural catastrophes and terrorism in more than 90 countries. More than 400 insurance, reinsurance, financial, corporate, and government clients rely on AIR software and services for catastrophe risk management, insurance-linked securities, detailed site-specific wind and seismic engineering analyses, agricultural risk management, and property replacement-cost valuation. AIR is a member of the Verisk Insurance Solutions group at Verisk Analytics and is headquartered in Boston with additional offices in North America, Europe, and Asia. For more information, please visit www.air-worldwide.com.

Although AIR's simulation methodology is a permissible technique for estimating potential losses, the methodology does have certain limitations. It is based on mathematical/statistical models that represent real-world systems. As with all models, these representations are not exact. The model relies on various assumptions, some of which are subject to uncertainty. Accordingly, the loss estimates generated by the model are themselves subject to uncertainty. The loss estimates and their associated probabilities are estimates of the magnitude of losses that may occur in the event of such natural hazards; they are not factual and do not predict future events. Actual loss experience can differ materially. The results are intended to function as one of several tools for use in analyzing estimated expected and potential losses from extreme events. The assumptions that AIR used in creating them may not constitute the exclusive set of reasonable assumptions and methodologies. The use of alternative assumptions and methodologies could yield materially different results.

# New York Compensation Insurance Rating Board

## Terrorism Loss Cost Filing, Proposed Effective 04/01/2015

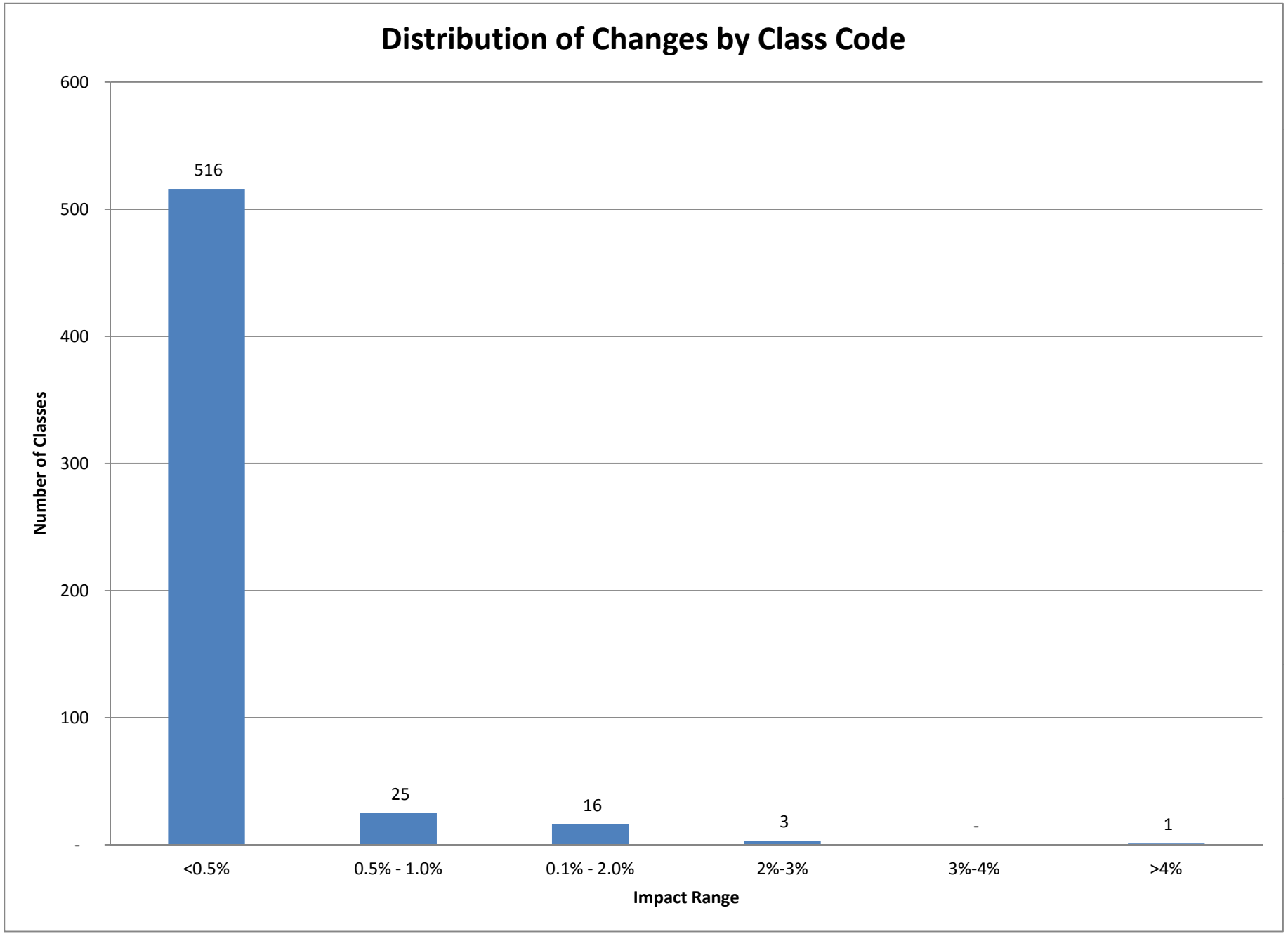
## Derivation of Loss Costs Based on Limited Payroll

| | | | |
|---|---|---|---|
| (1) | NYCIRB Reported Limited Payroll Amount (PY 2011)* | | $352 B |
| (2) | Self Insurance Estimate** | | 69% |
| (3) | Statewide Payroll (Limited) = (1) / (2) | | $510.14 B |
| | DOL Statewide Unlimited Payroll | | |
| (4) | A: Calendar Year 2011 | | $521 B |
| (5) | B: Calendar Year 2012 | | $537 B |
| (6) | C: Average of A and B: PY 2011 Estimate | | $529 B |
| (7) | Limited to Unlimited Payroll Ratio (3) / (6) | | 0.964 |
| (8) | Loss Cost based on unlimited payroll*** | $ | 0.042 |
| (9) | Loss Cost Based on limited payroll = (8) / (7) | $ | 0.044 |

* Source: Schedule Z

** Source: National Academy of Social Insurance Report: "*Workers' Compensation: Benefits, Coverage, and Costs, 2012"* , p. 21

*** AIR Report Supplement, page 7


Distribution of Changes by Class Code
600
500
400
300
200
100
-
Number of Classes
516
25
16
3
-
1
<0.5%
0.5% - 1.0%
0.1% - 2.0%
2%-3%
3%-4%
>4%
Impact Range

**NYCIRB**
**Terrorism Loss Cost Filing**
**Proposed Effective Date 04/01/2015**

**Impact of Terrorism Loss Cost Change**
**By Industry Group**

| Industry Group | Industry Group Description | % Impact |
|---|---|---|
| 1 | Food & Beverage Manufacturing | 0.1% |
| 2 | Chemical Manufacturing | 0.3% |
| 3 | All Other Manufacturing | 0.2% |
| 4 | Contracting | 0.1% |
| 5 | Stores and Dealers | 0.2% |
| 6 | Professional and Office | 1.5% |
| 7 | Services | 0.2% |
| 8 | Miscellaneous | 0.2% |
| 9 | Admiralty, FELA, Federal | 0.1% |