# BEFORE THE
# FLORIDA PUBLIC SERVICE COMMISSION
# DOCKET NO. 130040-EI

IN RE: TAMPA ELECTRIC COMPANY'S
PETITION FOR AN INCREASE IN BASE RATES
AND MISCELLANEOUS SERVICE CHARGES

COM 5
AFD 1
APA 1
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GCL 1
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TEL
CLK 1

## DIRECT TESTIMONY AND EXHIBIT
## OF
## STEVEN P. HARRIS
## ON BEHALF OF TAMPA ELECTRIC COMPANY

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**BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION**

**PREPARED DIRECT TESTIMONY**

**OF**

**STEVEN P. HARRIS**

**ON BEHALF OF TAMPA ELECTRIC COMPANY**

**Q.** Please state your name and business address.

**A.** My name is Steven P. Harris. My business address is EQECAT, INC. ("EQECAT"), 475 14th Street, Oakland, California 94612.

**Q.** Who is your employer and what is your position?

**A.** I am a Vice President with EQECAT, Inc., an affiliated company of ABS Consulting, both of which are subsidiaries of the ABS Group of Companies. Together these two companies are leading global providers of catastrophic risk management services, including software and consulting, to major insurers, re-insurers, corporations, governments and other financial institutions. In addition, these companies develop and license catastrophic underwriting, pricing, risk management and risk transfer models that are used extensively in the insurance industry. The companies provide the financial, insurance and brokerage communities with a science and technology-based source of independent quantitative risk information.

**Q.** Please describe your educational background and business experience.

**A.** I received Bachelors and Masters Degrees in engineering from the University of California at Berkeley. I am a licensed civil engineer in the State of California. Over the past 30 years, I have conducted and supervised independent risk and financial studies for public utilities, insurance companies and other entities both regulated and unregulated. My areas of expertise include natural hazard risk analysis, operational risk analysis, risk profiling and financial analysis, insurance loss analysis, loss prevention and control, business continuity planning and risk transfer.

A significant portion of my consulting experience has involved the performance of multi-hazard risk studies, including earthquake, ice storm and windstorm perils, for electric, water and telephone utility companies, as well as insurance companies.

I have performed or supervised windstorm (tropical storm or hurricane) loss, and reserve analyses for utilities including Tampa Electric Company ("Tampa Electric" or "company"), Florida Power & Light, Progress Energy Florida, Gulf Power Company, and others. Additionally, I have performed loss analyses for earthquake hazard for utilities including the Los Angeles Department of Water and Power, the Sacramento Municipal Utility District, and British Columbia Hydro.

For energy companies that have assets in a wide array of geographic locations, I have performed or supervised multi-peril analyses for all natural hazards, including earthquakes, windstorms and ice storms.

**Q.** Are you sponsoring an exhibit in this case?

**A.** Yes. I am sponsoring Exhibit No. ___ (SPH-1), entitled "Exhibit of Steven P. Harris on Behalf of Tampa Electric Company", which was prepared under my direction and supervision. It consists of one document, "Transmission and Distribution Assets - Storm Loss and Reserve Performance Analysis".

**Q.** What is the purpose of your direct testimony?

**A.** My direct testimony presents the results of EQECAT's independent analyses of risk of uninsured losses to Tampa Electric's transmission and distribution assets and insurance retentions from hurricanes and tropical storms. These studies include storm loss analysis and reserve performance analysis.

**Q.** Please briefly describe the studies performed for Tampa Electric.

**A.** EQECAT performed two analyses relative to the reserve: The Storm Loss Analysis ("Loss Analysis"), and The Reserve Performance Analysis ("Performance Analysis"). The Loss Analysis is a probabilistic windstorm analysis that uses proprietary software to develop an estimate of the expected annual amount of uninsured windstorm losses to which Tampa Electric is exposed. The Reserve Performance Analysis is a dynamic financial simulation analysis that evaluates the performance of the reserve in terms of the expected balance of the reserve and the likelihood of positive reserve balances over a five-year prospective period, given the potential uninsured losses determined from the Loss Analysis, at various annual accrual levels.

**Q.** Please summarize the results of your analyses.

**A.** The Loss Analysis was performed to estimate the level of annual damage that Tampa Electric is exposed to from hurricanes and tropical storms. The Reserve Performance Analysis was performed to test three levels of possible annual accrual to the reserve. This analysis tests the performance of the reserve against the potential storm losses determined from the Loss Analysis. The accrual levels tested are the company's current $8 million per year accrual as well as two other higher levels of $12 million and $20 million. The study estimated the total expected average annual uninsured cost to Tampa Electric from all storms to be $21.9 million.

The Reserve Performance Analysis demonstrated that an accrual level of $8 million would result in an expected reserve deficit of negative ($5.6 million) and a probability of negative reserve balances of 32 percent within the five-year simulation time horizon. The Reserve Performance Analysis also demonstrated that an accrual level of $12 million would result in an expected reserve balance of $14 million and a probability of negative reserve balances of 26 percent within the five-year simulation time horizon. Finally, the Reserve

Performance Analysis demonstrated that an accrual level of $20 million would result in an expected reserve balance of $55 million and a probability of negative reserve balances of 18 percent within the five-year simulation time horizon.

**LOSS ANALYSIS**

**Q.** Please summarize the Loss Analysis.

**A.** The Loss Analysis determined the expected annual magnitude of windstorm losses to Tampa Electric's transmission and distribution ("T&D") system. Windstorm losses include costs associated with service restoration and repair of Tampa Electric's T&D system as a result of hurricanes and tropical storms. Also included are estimates of the costs of windstorm insurance deductibles attributable to non-T&D assets.

**Q.** Please describe the computer software used to perform the Loss Analysis.

**A.** USWIND™ is a probabilistic model designed to estimate damage and losses due to the occurrence of storms. EQECAT's proprietary computer software USWIND™ is one of only four models evaluated and determined acceptable by the Florida Commission on Hurricane Loss Projection Methodology for projecting hurricane loss costs.

Probabilistic annual damage and loss is computed using the results of over 100,000 random variable storms. Annual damage and loss estimates are developed for each individual site and aggregated to overall portfolio damage and loss amounts. USWIND™ climatological models are based on the National Oceanic and Atmospheric Administration's ("NOAA") National Weather Service Technical Reports.

**Q.** Does USWIND™ take into account storm frequency and severity?

**A.** Yes. The analysis is based on storm frequency and severity distributions developed from the entire 109-year historical record. USWIND™ also allows the estimation of frequency of storms in the current period of heightened hurricane activity.

**Q.** Please describe the current period of heightened hurricane activity.

**A.** Hurricanes are known to occur in multi-year cycles. The recent decades of the 1970s through the mid-1990s had significantly lower activity than the 109-year long-term average. Other decades have had periods of higher activity. NOAA has expressed its belief that we entered a period of increased hurricane formation around 1995.

There is the emerging consensus that changes in the El Niño/Southern Oscillation and North Atlantic Oscillation variables indicate we have entered a more active period for hurricane formation, like that experienced in the 1920s and 1940s. Therefore, Tampa Electric may expect to experience higher damage to its T&D assets over the next several years than would be predicted by the long-term hurricane hazard.

The Loss Analysis is based on hurricane frequency and severity distributions that are reflective of the relatively more active periods of the 1920s and 1940s. The length of these active periods is thought to be about 25 to 40 years or more, and the recent period of higher activity is believed to have begun over a decade ago.

The hurricane hazard cases analyzed therefore represent frequencies associated with the current period that may be associated with a higher frequency of hurricane formation. If the view held by NOAA and other meteorological experts is correct, we may expect to see larger numbers of hurricanes form and larger numbers of landfalls in the coming decades than we have in the pre-1995 period.

**Q.** Do the storm frequency assumptions include the possibility of having multiple hurricane landfalls within Florida in any given year?

**A.** Yes. USWIND™ does include the possibility of having multiple hurricane landfalls within Florida in any given year, including the impact of such landfalls on aggregate losses, consistent with the 2004 hurricane season when multiple landfalls in Florida occurred.

**Q.** Did the Loss Analysis take into account the frequency of storms during the 2004 and 2005 storm seasons?

**A.** The current analysis takes into account the hurricane history including the 2004 and 2005 storm seasons.

**Q.** What were the results of the Loss Analysis?

**A.** The total expected annual uninsured cost to Tampa

Electric's system from all storms is estimated to be $21.9 million.

**Q.** What does this expected annual loss estimate represent?

**A.** The expected annual loss estimate represents the average annual cost associated with damage to T&D assets, insurance deductibles for damage to other assets such as generating plants and substations, and service restoration activities resulting from windstorms over a long period of time.

**Q.** Is the Loss Analysis performed for Tampa Electric the same analysis performed for insurance companies to price an insurance premium?

**A.** Yes. The natural hazards loss modeling and analysis would be similar for an insurance company, electric utility or other entity. The expected annual loss is also known as the "pure premium". When insurance is available, the pure premium is the insurance premium level needed to pay just the expected losses. Although insurance companies would add their expenses and profit margin to the pure premium to develop the premium charged to customers, those costs are not reflected in EQECAT's analyses results.

## RESERVE PERFORMANCE ANALYSIS

**Q.** Please summarize the Reserve Performance Analysis.

**A.** EQECAT performed a dynamic financial simulation analysis of the impact of the estimated windstorm losses on the reserve for specified levels of annual funding. The starting assumption for the Reserve Performance Analysis was a reserve balance of $50.2 million. This Performance Analysis performed 10,000 simulations of windstorm losses within the Tampa Electric service territory, each covering a five-year period, to determine the effect of the charges for loss on the reserve.

The analysis technique used relies on repeated sampling to model multiple storm seasons and simulates variable storm losses consistent with the results of the Loss Analysis. Because storm seasons and losses are highly variable, 10,000 five-year simulations are performed to estimate the performance of the reserve with various accrual levels and ensure an adequate number of samples of rare storm events. Monte Carlo simulations were used to generate damage samples for the analysis.

The simulations were used to generate loss samples consistent with the expected annual loss from the Loss Analysis results. $17.6 million of the $21.9 million Expected Annual Loss determined in the Loss Analysis is assumed to be an obligation of the reserve annually. The analysis provides the expected balance of the reserve in each year of the simulation accounting for the annual accrual and losses using a financial model.

**Q.** How are the results of the Loss Analysis used in the Reserve Performance Analysis?

**A.** Both the likelihoods and amounts of uninsured annual losses determined in the Loss Analysis are used to simulate losses in each of the five years in the Performance Analysis in order to determine the likelihood of the reserve having positive balances.

**Q.** Please describe the assumptions that were included in the Reserve Performance Analysis.

**A.** All computations were performed with an initial reserve balance of $50.2 million and all results are shown in constant 2012 dollars. The analysis also assumed future growth of the customer base and system assets and inflationary cost increases for new T&D assets of 4.5 percent annually.

**Q.** Please summarize the results of the Reserve Performance Analysis.

**A.** Reserve performance can be viewed in terms of the expected or mean balance of the reserve and the likelihood of positive reserve balances occurring within the five-year period. Based on the simulated loss distributions, there is some likelihood of negative reserve balances for each of the annual accrual levels analyzed. Higher accrual levels will result in a lower probability of negative reserve balances, and will have a higher probability of a positive reserve balance at the end of the five-year simulation period. If the annual accrual levels are smaller, there is a greater chance of negative reserve balances, especially in the early years.

**TAMPA ELECTRIC'S RECOMMENDED ACCRUAL**

**Q.** Did you make a recommendation for Tampa Electric's annual level of accrual?

**A.** No. My role was not to recommend an annual level of accrual. It was to present probabilities to Tampa

Electric regarding reserve performance based on various levels of annual accrual. There are large uncertainties associated with the hurricane hazard and the specific storm outcomes have large variances. There could be hurricane seasons with no loss at all and hurricane seasons with hundreds of millions of dollars in losses. The Performance Analysis presents information about the likelihood of the adequacy of funding that can be used to make decisions about the reserve.

**Q.** Did you analyze a range of annual accrual levels in your evaluation?

**A.** Yes. My evaluation included analyses of the reserve performance at the current annual accrual level of $8 million, and at the annual accrual levels of $12 million and $20 million.

**Q.** What is the likelihood of the company's reserve having an inadequate balance at the current annual accrual level of $8 million?

**A.** At the current annual accrual level of $8 million, the likelihood of the reserve having negative balances within the five-year period is 32 percent, and it is estimated that the reserve would have a deficit of negative ($5.6 million) at the end of five years.

**Q.** What did your evaluation show with respect to a $20 million accrual?

**A.** At an annual accrual level of $20 million, the likelihood of the reserve having negative balances within the five-year period is 18 percent, and the expected balance of the reserve at the end of five years would be approximately $55 million.

**Q.** Would a $20 million accrual cover all potential storm loss outcomes?

**A.** No. The expected or mean balance of $55 million has a 50 percent chance of being exceeded. The analysis also provides estimates of the fifth percentile and ninety-fifth percentile reserve balances. At the fifth percentile reserve balance, only five percent of the simulated outcomes have smaller values. Similarly, for the ninety-fifth percentile reserve balance, only five percent of simulated outcomes have values which would be greater than that value. The fifth percentile represents an extremely adverse five years of storm experience where the losses would far exceed the reserve levels. Conversely, the ninety-fifth percentile line would represent an extremely favorable five years of storm experience where only five percent of simulated reserve outcomes would be greater than the estimated balance, or five years of very small or no storm damage.

**Q.** What is your conclusion with respect to the $8 million annual level of accrual selected by Tampa Electric?

**A.** My analysis indicates that, with an expected annual loss obligation of $17.6 million and an annual accrual of $8 million, the balance of the reserve at the end of five years is expected to be a negative ($5.6 million). This represents a significant decrease in reserve from the initial balance of $50.2 million. There is about a one in three chance that storm losses would create a deficit in the reserve within the five-year period. Additionally, even with an extremely favorable five-year storm experience there is no chance that the reserve balance would reach $100 million. Tampa Electric's recommendation appears reasonable and appropriate.

**Q.** Does this conclude your direct testimony?

**A.** Yes.

# EXHIBIT

# OF

# STEVEN P. HARRIS

# ON BEHALF OF TAMPA ELECTRIC COMPANY

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EXHIBIT NO. ___ (SPH-1)
WITNESS: HARRIS
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EQECAT
An ABS Group Company

# Tampa Electric

TECO
TAMPA ELECTRIC

# Storm Loss and Reserve Performance Analysis

January
2013

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## Tables



## Figures

## Figures (Continued)

## DISCLAIMER

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# Risk Profile

The following is a summary description of analyses performed by EQECAT of Tampa Electric storm loss exposure and reserve performance. This report is intended to be used solely by Tampa Electric and the Florida Public Service Commission for estimation of potential future Tampa Electric losses to the reserve and the estimation of the performance of the reserve.

| **OWNER** | **Tampa Electric** | |
|---|---|---|
| **ASSETS** | Transmission and Distribution (T & D) System: Transmission towers, and conductors; Distribution poles, transformers, conductors, lighting and other miscellaneous assets; Non-recovered property insurance policy deductibles. | |
| **LOCATION** | All T & D assets located within the State of Florida, | |
| **ASSET VALUE** | Normal replacement value is approximately $ 4.1 billion, of which approximately 11% is transmission and 89% is distribution | |
| **LOSS PERILS** | Hurricane Windstorm (SSI 1 to 5), Tropical Storms | |
| **EXPECTED ANNUAL LOSS (T&D and deductibles)** | $21.9 million | |
| **1% AGGREGATE DAMAGE EXCEEDANCE VALUE** | $357 million | |
| | **Reserve Performance** | |
| **Reserve Analysis Cases $50.2 m initial balance** | **Expected balance at 5 years** | **Probability of negative balance within 5 years** |
| $8 million Annual Accrual | ($5.6 million) | 32% |
| $12 million Annual Accrual | $14 million | 26% |
| $20 million Annual Accrual | $55 million | 18% |

# 1. Storm Loss Analysis

Tampa Electric transmission and distribution (T & D) systems and general property are exposed to and in the past have sustained damage from hurricanes and tropical storms. The exposure of these assets to storm damage is described and potential losses are quantified. Loss analyses were performed by EQECAT, using an advanced computer model simulation program WORLDCATenterprise™ developed by EQECAT, an ABS Group Company. All results which are presented here have been calculated using WORLDCATenterprise, and the Tampa Electric provided T & D asset portfolio data.

The storm exposure is analyzed from a probabilistic approach, which considers the full range of potential storm characteristics and corresponding losses. Probabilistic analyses identify the probability of damage exceeding a specific dollar amount. WORLDCATenterprise is a probabilistic model designed to estimate damage and losses due to the occurrence of hurricanes. EQECAT proprietary computer software WORLDCATenterprise is one of only four models evaluated and determined acceptable by the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) for projecting hurricane loss costs (Reference 1).

Probabilistic Annual Damage & Loss is computed using the results of thousands of random variable storms. Annual damage and loss estimates are developed for each individual site and aggregated to overall portfolio damage and loss amounts. Damage is defined as the cost associated with repair and/or replacement of T & D assets necessary to promptly restore service in a post-storm environment. This cost is typically larger than the costs associated with scheduled repair and replacement programs.

Factors considered in the analysis include the location of Tampa Electric's overhead and underground T & D assets, the probability of storms of different intensities and/or landfall points impacting those assets, the vulnerability of those assets to storm damage, and the costs to repair assets and restore electrical service.

Transmission and Distribution asset data are provided in the Tables 1-1 and 1-2 below. Distribution and transmission asset values by zip code are shown in Figure 1-1 and Figure 1-2 respectively.

Table 1-1

**DISTRIBUTION ASSET REPLACEMENT VALUES BY COUNTY**

| County | Replacement Value ($000) |
|---|---|
| Hardee | $2,194 |
| Hillsborough | $2,898,510 |
| Manatee | $6,987 |
| Pasco | $134,212 |
| Pinellas | $68,539 |
| Polk | $488,833 |
| **Total** | **$3,599,275** |

Table 1-2

**TRANSMISSION ASSET REPLACEMENT VALUE**

| | Replacement Value ($000) |
|---|---|
| **TOTAL** | **$462,028** |

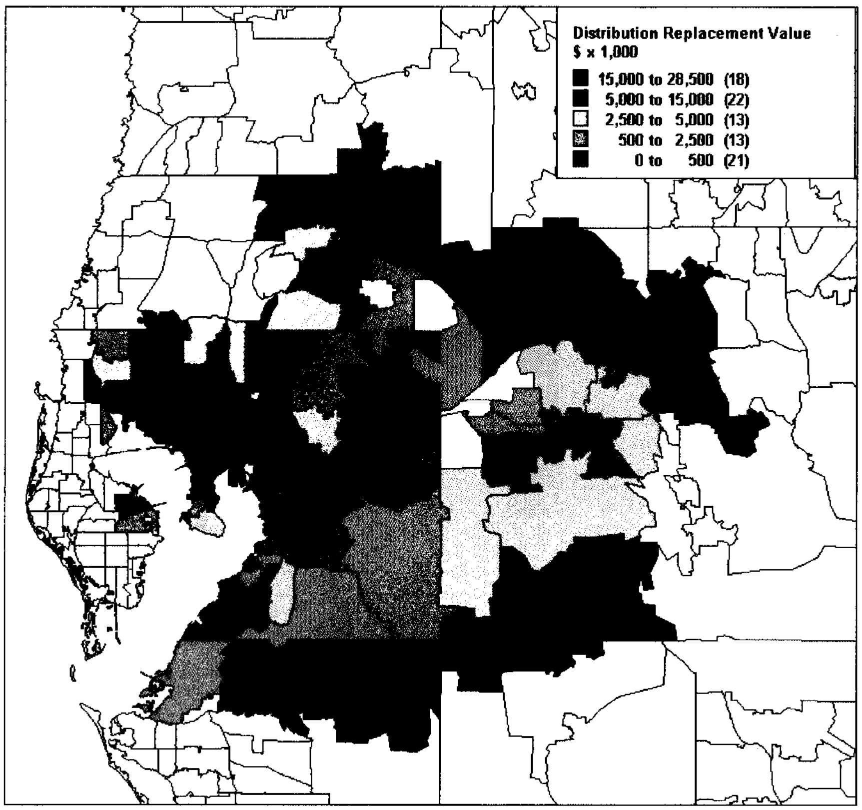


Figure 1-1: Distribution Asset Values by Zip Code

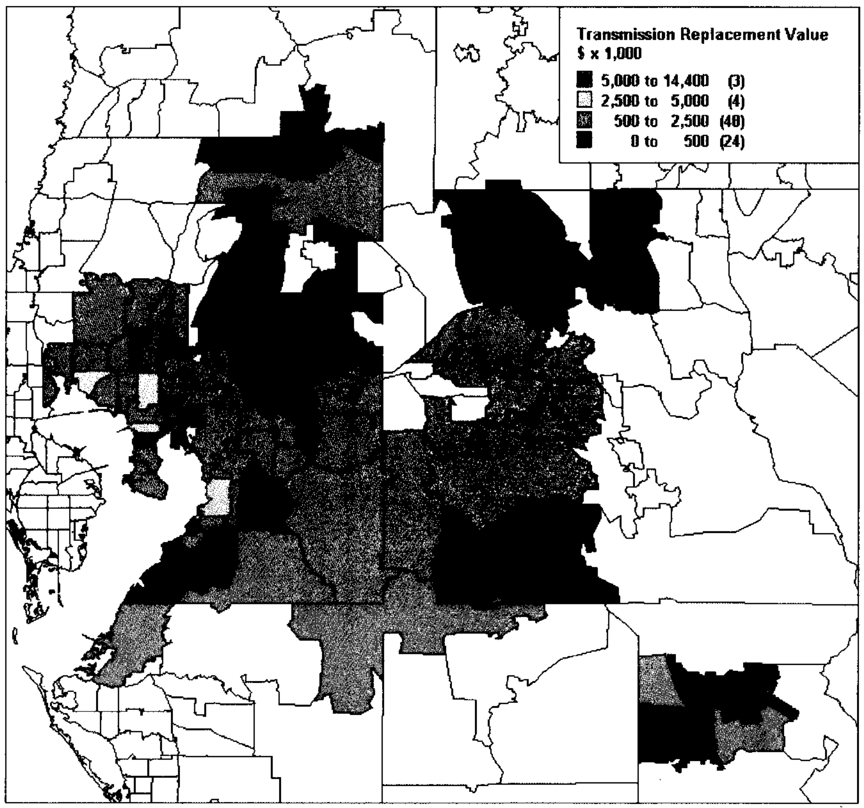


Figure 1-2: Transmission Asset Values by Zip Code

**Transmission and Distribution Asset Vulnerabilities**

The Tampa Electric loss history from the 2004 Hurricanes Charley, Frances, and Jeanne were considered in the calibration of the storm loss model. These hurricanes provide data on recent storm recovery costs from low intensity winds. The 2004 storm loss experience includes the effects of many factors including the post hurricane costs of labor and other factors associated with the storm restoration process utilized by Tampa Electric. The 2004 loss history is believed to be most reflective of the current Tampa Electric storm restoration practices and cost experience.

**Insured Property Policy Deductibles**

Tampa Electric insured property was also modeled for hurricane loss potential. The insured property consisted of power plants, general buildings and substations. The model analyzed the property exposures and the Tampa Electric insurance policy which requires the insured's retention of up to the first $25 million loss per storm occurrence. These non-recovered deductible losses were estimated using WORLDCATenterprise and a methodology similar to that described above.

**Loss Estimation Methodology**

The basic components of the hurricane risk analysis include:

- **Assets at risk:** define and locate
- **Storm hazard**: apply probabilistic storm model for the region
- **Asset vulnerabilities:** severity (wind speed) versus damage
- **Portfolio Analysis:** probabilistic analysis -damage/ loss

# 2. Hurricane Hazard

**Hurricane Exposure**

The hurricane exposure is analyzed from a probabilistic approach, which considers the full range of potential hurricane characteristics and corresponding losses. Probabilistic analyses identify the probability of damage exceeding a specific dollar amount. WORLDCATenterprise is a probabilistic model designed to estimate damage and losses due to the occurrence of hurricanes. EQECAT, Inc. proprietary computer software WORLDCATenterprise is one of only four models evaluated and determined acceptable by the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) for projecting hurricane loss costs (Reference 1).

The historical annual frequency of hurricanes has varied significantly over time. There are many causes for the temporal variability in hurricane formation. While stochastic variability is a significant factor, many scientists believe that the formation of hurricanes is also related to climate variability.

One of the primary climate cycles having a significant correlation with Hurricane activity is the Atlantic Multidecadal Oscillation (AMO). It has been suggested that the formation of hurricanes in the Atlantic Ocean off the coast of Africa is related to the amount of rainfall in the Western African Sahel region. Years in which rainfall is heavy have been associated with the formation of a greater number of hurricanes. The AMO cycle consists of a warm phase, during which the tropical and sub-tropical North Atlantic have warmer than average temperatures at the surface and in the upper portion relevant to hurricane activity, and a cool phase, during which these regions of the ocean have cooler than average temperatures. In the period 1900 through 2010, the AMO has gone through the following phases:

| | | |
|---|---|---|
| 1900 through 1925 | Cool | (Decreased Hurricane Activity) |
| 1926 through 1969 | Warm | (Increased Hurricane Activity) |
| 1970 through 1994 | Cool | (Decreased Hurricane Activity) |
| 1995 through 2010 | Warm | (Increased Hurricane Activity) |

The National Oceanic and Atmospheric Administration (NOAA) believes that we entered a warm phase of AMO around 1995 which can be expected to continue for at least several years; historically, each phase of AMO has lasted approximately 25 to 40 years. This view of the current period of increased hurricane activity is reflected in the analyses.

Probabilistic Annual Damage & Loss is computed using the results of thousands of random variable hurricanes. Annual damage estimates are developed for each individual site and aggregated to overall portfolio damage amounts. Damage is defined as the total cost including the operations and maintenance (O&M) and capital components associated with repair and/or replacement of T & D assets necessary to promptly restore service in a post storm environment. This cost is typically larger than the costs associated with scheduled repair and replacement programs.

Factors considered in the analysis include the location of Tampa Electric's overhead and underground T & D assets, the probability of hurricanes of different intensities and/or landfall points impacting those assets, the vulnerability of those assets to hurricane damage, and the costs to repair assets and restore electrical service.

# 3. Storm Loss Analysis Results

**Aggregate Loss Exceedance and Expected Annual Loss**

A probabilistic database of T&D and insured property deductible losses is developed using the storm hazard, assets at risk and their vulnerabilities. The analysis reflects the current view that we are in a period of heightened hurricane formation. For each hurricane, the center, shape, geographical orientation, track and wind speeds were defined. The wind field for each storm is integrated with the asset vulnerability and the asset locations to compute the damage. The annual frequency and the portfolio damage for each is simulated. By manipulating this database of thousands of hurricane losses, various loss exceedance or non-exceedance distributions are generated.

The frequencies and computed damage for all hurricanes are combined to calculate the expected annual loss (EAL) and the annual aggregate exceedance relations.

Aggregate damage exceedance calculations are developed by keeping a running total of damage from ***all possible events*** in a year. At the end of year, the aggregate damage for all events is then determined by probabilistically summing the damage distribution from each event, taking into account the event frequency. The process considers the probability of having zero events, one event, two events, etc. during a year.

A series of probabilistic analyses were performed, using the vulnerability curves derived for Tampa Electric assets and the computer program WORLDCATenterprise. A summary of the analysis is presented in Table 3-1, which shows the aggregate loss exceedance probability for damage layers between zero and over $360 million dollars.

For each damage layer shown, the probability of damage exceeding a specified value is shown. For example, the probabilities of loss exceeding $100 million in one year is 4.43%. The analysis calculates the probability of damage from all storms and aggregates the total.

Tables 3-1 provides the aggregate loss exceedance probabilities for the Tampa Electric T & D damage and property deductibles analyzed for a series of layers. Each layer has a layer amount of $20 million, except for the final layer which represents all damage $360 million and greater. The value in the first column, labeled Loss Layer, is the attachment point for each layer, with the exception of the last layer, for which the attachment point is $360 million.

The second column of the table, labeled 1 year Exceedance Probability, provides the annual modeled probability of penetrating each layer, i.e. the probability that the total damage from all events in a 1 year period will exceed the attachment point of the layer.

The expected annual loss (EAL) from hurricane and tropical storm damage to T&D and insured property deductibles is $21.9 million This value represents the average loss from all simulated storms. The EAL is not expected to occur each and every year. Some years will have no damage from storms, some years will have small amounts of damage and a few years will have large amounts of damage. The EAL represents the average of all storm years over a long period of time.

It should be noted that the National Oceanographic and Atmospheric Administration (NOAA) believes that in 1995 we entered a period of heightened hurricane formation in the Atlantic Basin and near term frequencies of hurricanes over the coming decade should be expected to be significantly higher than those over the long term.

Table 3-1

**TAMPA ELECTRIC T & D ASSETS AND DEDUCTIBLES AGGREGATE LOSS EXCEEDANCE PROBABILITIES**

| Loss Layer ($millions) | 1 Year Exceedance Probability |
|---|---|
| (≥ 0.5) | 58.6% |
| 20 | 24.5% |
| 40 | 14.2% |
| 60 | 8.68% |
| 80 | 5.90% |
| 100 | 4.43% |
| 120 | 3.56% |
| 140 | 2.98% |
| 160 | 2.57% |
| 180 | 2.26% |
| 200 | 2.02% |
| 220 | 1.82% |
| 240 | 1.65% |
| 260 | 1.50% |
| 280 | 1.37% |
| 300 | 1.26% |
| 320 | 1.16% |
| 340 | 1.07% |
| >360 | 0.99% |

# 4. Hurricane Landfall Analyses for SSI Ranges

In order to provide further insight into Tampa Electric's risk profile, the full set of stochastic hurricane events were analyzed by landfall for four hurricane intensities, SSI 1 through 4. The landfall locations are at mileposts from about 1090 to 1300 on the Gulf Coast. The Figure below illustrates the landfall locations. The mileposts extend east from Cross City, FL near milepost 1090 to Fort Meyers near milepost 1290 in 10 mile intervals.

The full set of stochastic hurricanes within each SSI category was analyzed for Tampa Electric's T&D portfolio. For each milepost and SSI category, the frequency-weighted average damage was computed from all stochastic hurricanes making landfall within 10 nautical miles of a given milepost and within that SSI category. Figures 4-2 through 4-5 provide these results.

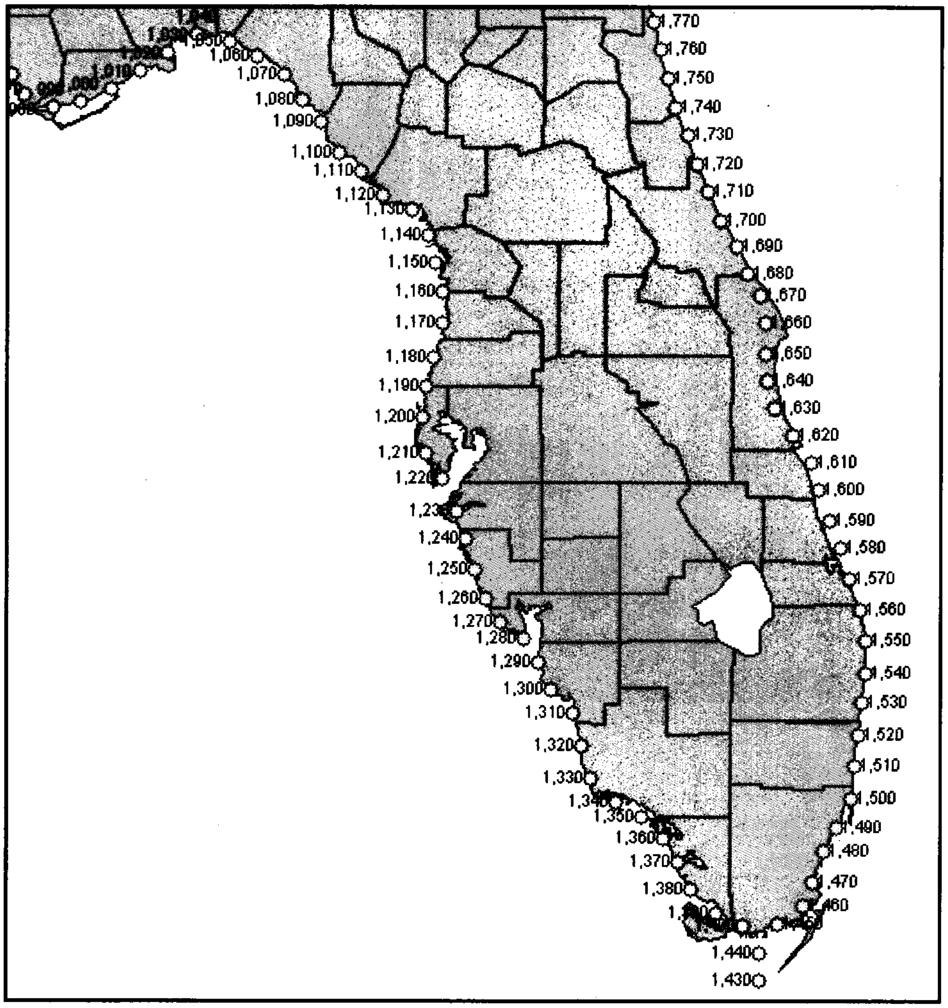


Figure 4-1: Hurricane Landfall Milepost

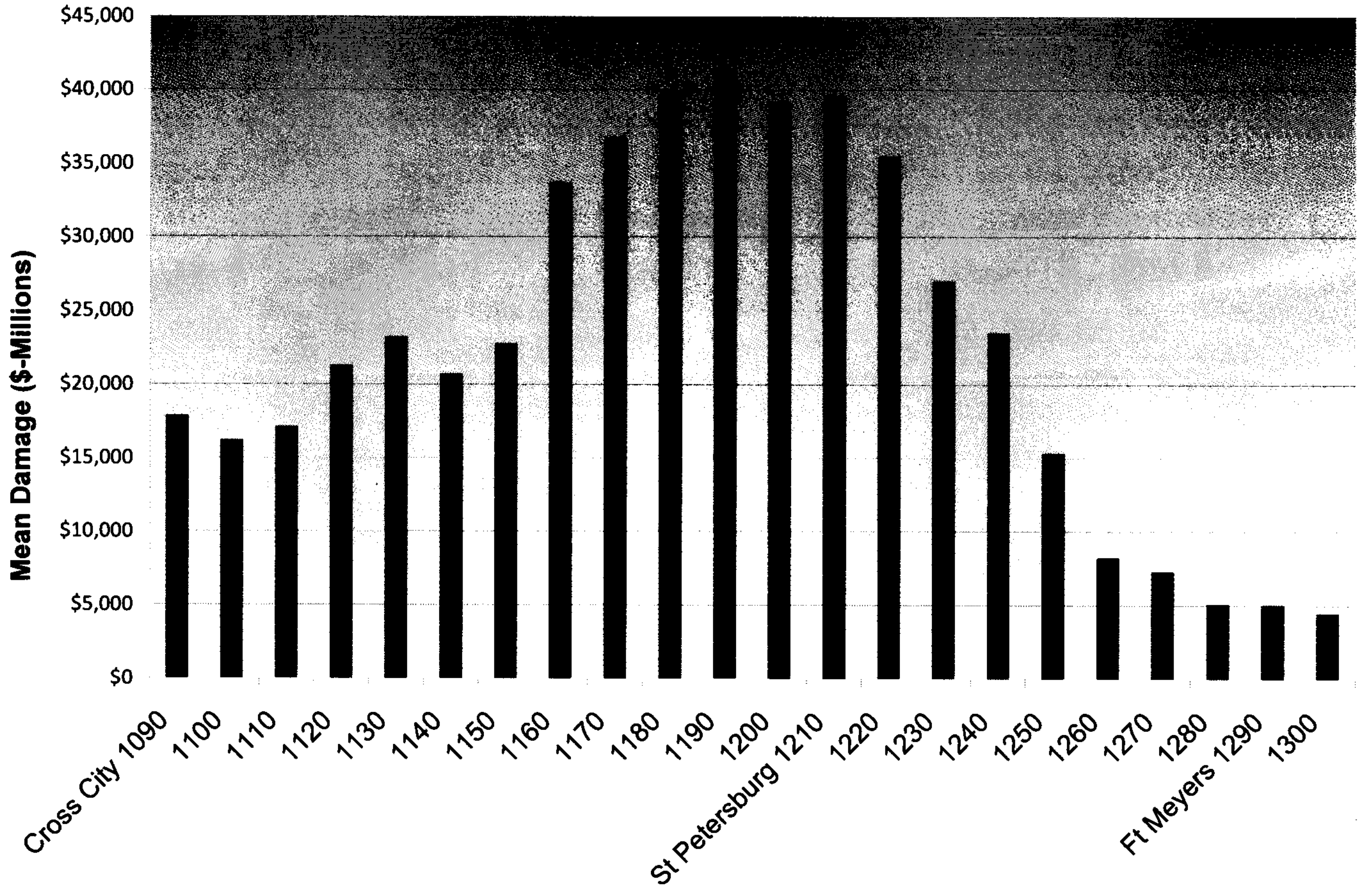


Figure 4-2: Frequency Weighted Average Transmission & Distribution Damage from Single SSI 1 Landfalls

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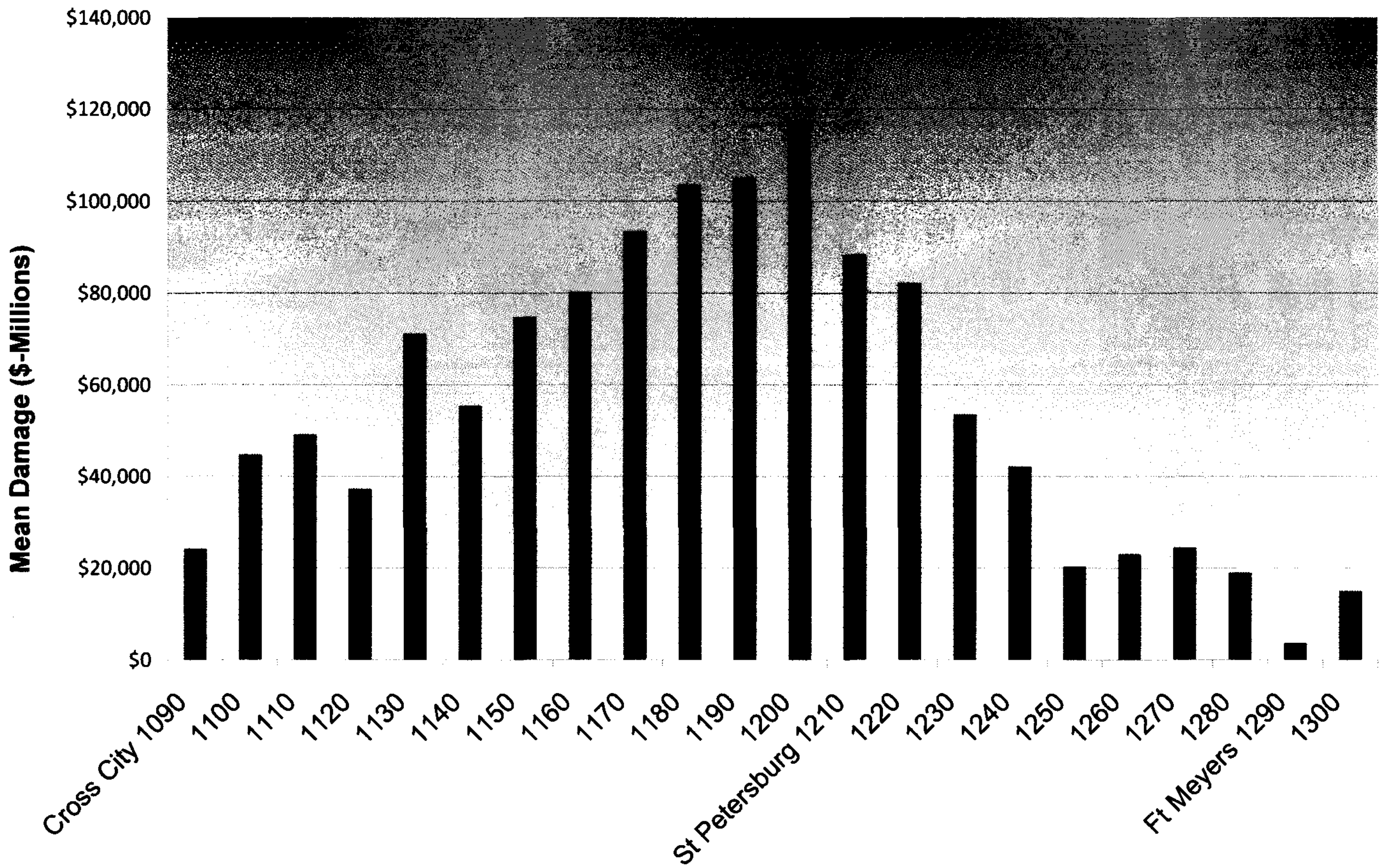


Figure 4-3: Frequency Weighted Average Transmission & Distribution Damage from Single SSI 2 Landfalls

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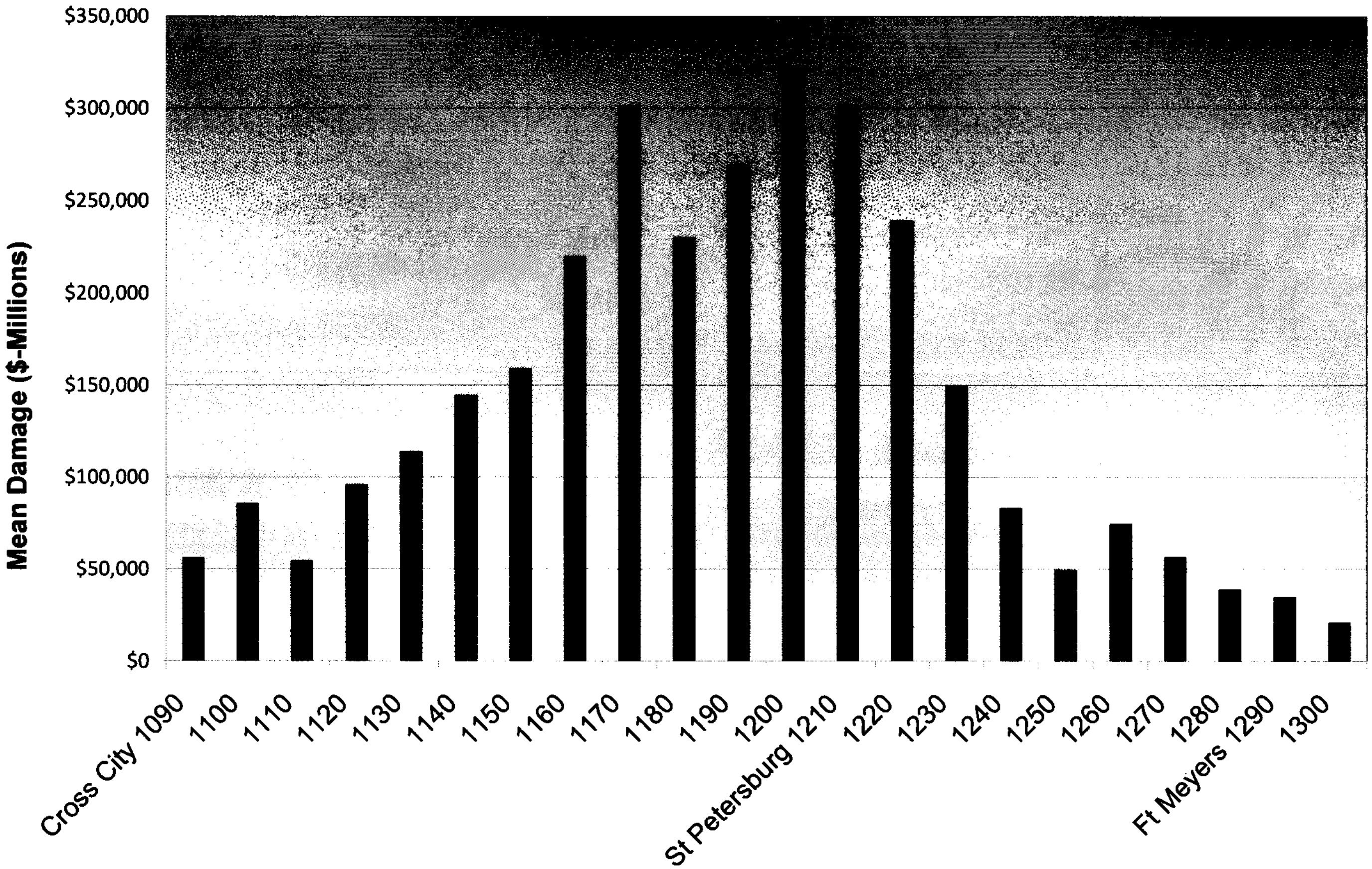


Figure 4-4: Frequency Weighted Average Transmission & Distribution Damage from Single SSI 3 Landfalls

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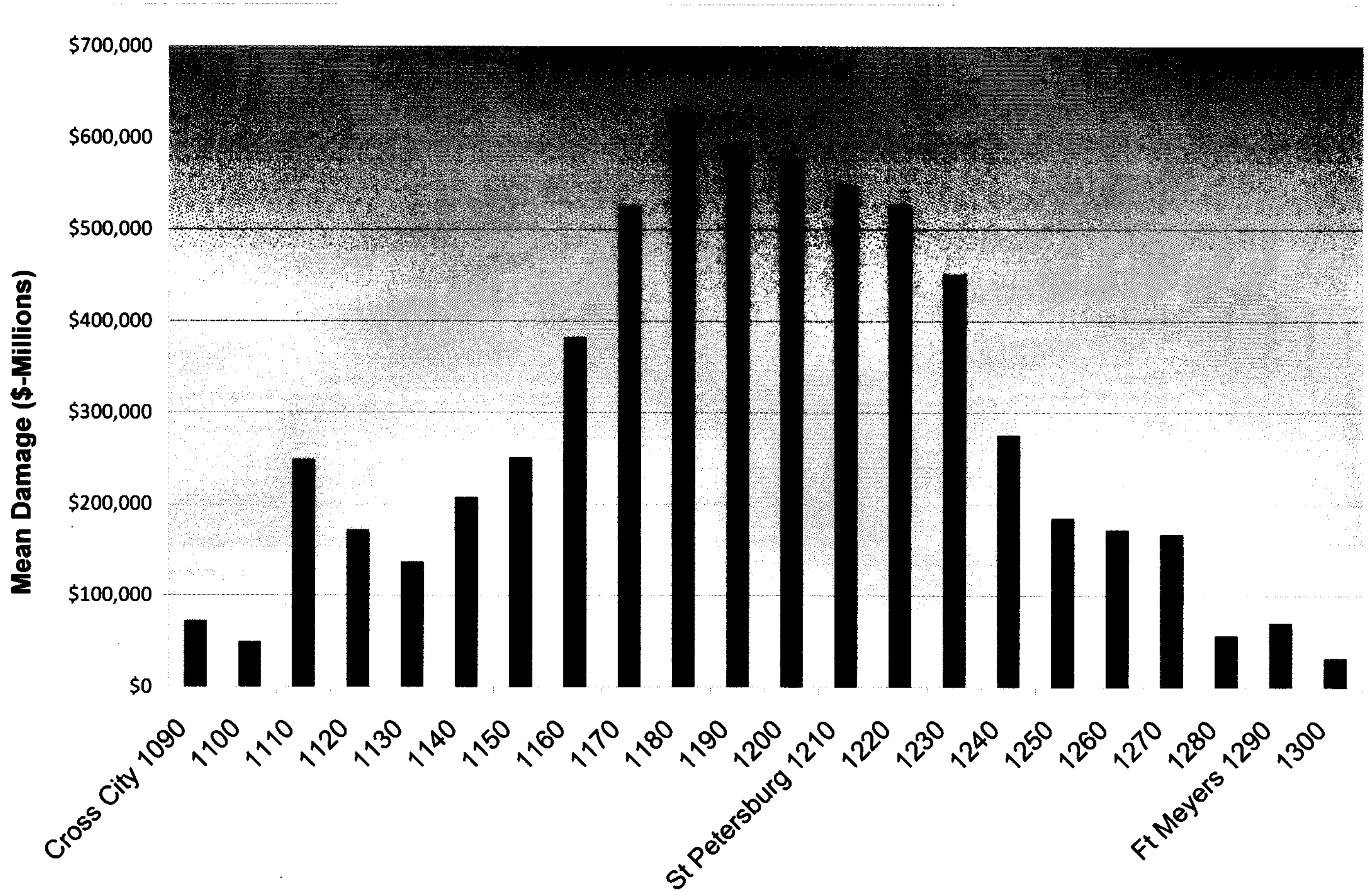


Figure 4-5: Frequency Weighted Average Transmission & Distribution Damage from Single SSI 4 Landfalls

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# 5. Reserve Performance Analysis

A probabilistic analysis of losses from hurricanes was performed for Tampa Electric to determine their potential impact on the reserve. The analysis included transmission and distribution (T & D) damage as well as estimates of insurance deductibles paid on insured property assets.

**Analysis**

The Reserve Performance Analysis consisted of performing 10,000 iterations of hurricane loss simulations within the Tampa Electric service territory, each covering a 5-year period, to determine the effect of the charges for damage on the Tampa Electric reserve. Monte Carlo simulations were used to generate damage samples for the analysis. The analysis provides an estimate of the reserve assets in each year of the simulation, accounting for the annual accrual and storm damage using a dynamic financial model.

The analyses consider three accrual cases, each with an initial $50.2 million reserve balance. The cases have annual accruals of $8 million, $12 million and $20 million over the five year period.

**Assumptions**

The analyses performed included the following assumptions:

- An initial reserve balance of $50.2 million for all cases.
- Storm losses are assumed to increase by 4.5% per year as replacement values of T&D increase due to inflation and system growth.
- $17.6 million of the $21.9 million Expected Annual Loss, determined in the Loss Analysis, is assumed to be an obligation of the reserve annually.
- Storm losses include estimates of property insurance policy deductibles up to the policy limit of $25 million per occurrence.

The results for the cases analyzed are shown in Tables 5-1a and b below. The results show the annual reserve accrual amount, the mean (expected) reserve balance as well as the probability that the reserve balance will be negative in any one or more of the five years of the simulated time horizon.

Table 5-1a

**RESERVE ACCRUALS AND RESERVE BALANCES FOR ANNUAL ACCRUAL CASES ($ Millions)**

| Reserve Balance at the end of 5 years | | | |
|---|---|---|---|
| Expected Annual Loss | $17.6 | | |
| Accrual | 5%ile | Mean | 95%ile |
| $8 | ($285) | ($5.6) | $83 |
| $12 | ($271) | $14 | $103 |
| $20 | ($224) | $55 | $144 |

Table 5-1b

**RESERVE ACCRUALS AND PROBABILITY OF RESERVE BALANCES ($ Millions)**

| Accrual | Mean Reserve Balance at the end of 5 years | Probability of Balance <$0 in 5 years | Probability of Balance >$100m in 5 years |
|---|---|---|---|
| $8 | ($5.6) | 32% | 0% |
| $12 | $14 | 26% | 8% |
| $20 | $55 | 18% | 56% |

Figures 5-1 through 5-3 show the results of the $50.2 million initial balance, and $8 million, $12 million and $20 million contribution cases. These results show the mean (expected) reserve balance as well as the 5th and 95th percentile reserve balances.

For example, given an initial reserve balance of $50.2 million and the specified $8 million, Figures 5-1 illustrates the expected performance of the reserve. The reserve has a mean (expected) Balance of negative ($5.6 million) at the end of the five-year period. The 5th percentile and 95th percentile 5 year ending reserve balances are negative ($285 million) and $83 million respectively. The reserve has a 32% chance of negative balances in one or more years of the five-year simulation.

The annual accrual of $8 million is less than the Expected Annual Loss to the reserve of $17.6. Therefore with each passing year, the reserve ending balance has a decreasing likelihood of accumulating surpluses and an increasing likelihood of negative balances. The expected (mean) reserve balance declines rapidly over the five-year simulation to negative values

Figures 5-2 through 5-3 below show the results of the $12 million and $20 million annual accrual cases. The annual accruals of $12 million to $20 million for these cases are nearer to the Expected Annual Loss to the reserve of $17.6. The EAL would be expected to grow at a 4.5% annual rate due to inflation and system growth to about $21 million at the end of the five year period. At the end of the five year period, the EAL value would also be close to the $20 million accrual level. Therefore, for the $20 million accrual case, with each passing year, the reserve ending balance has an increasing likelihood of accumulating surpluses and a decreasing likelihood of negative balances. The expected (mean) reserve balance increases slowly over the five-year simulation from the initial balance of $50.2 million to $56 million, for the highest $20 million accrual case, shown in Figure 5-3.

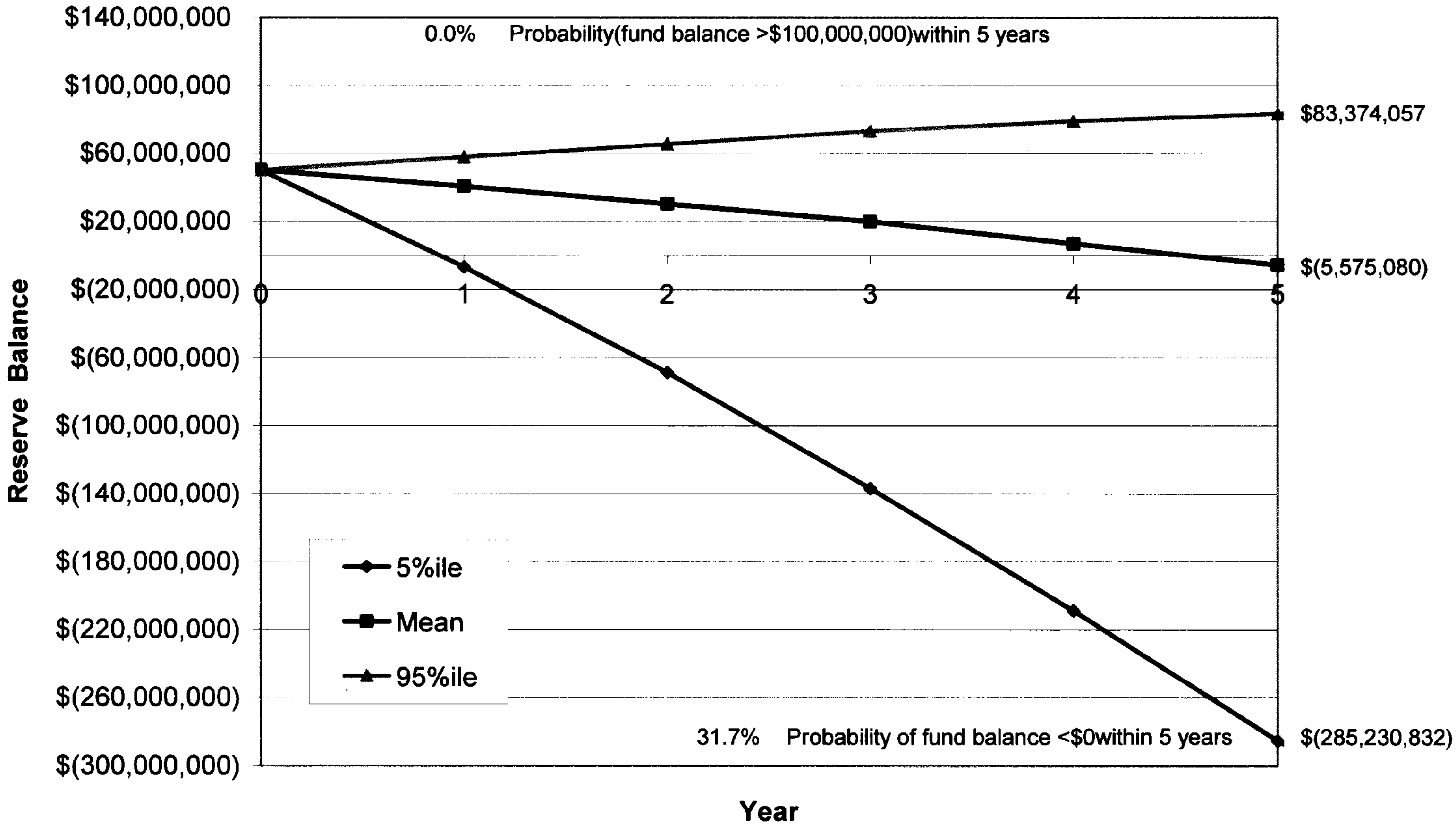


Figure 5-1: $50.2 million initial balance, $8 million annual accrual

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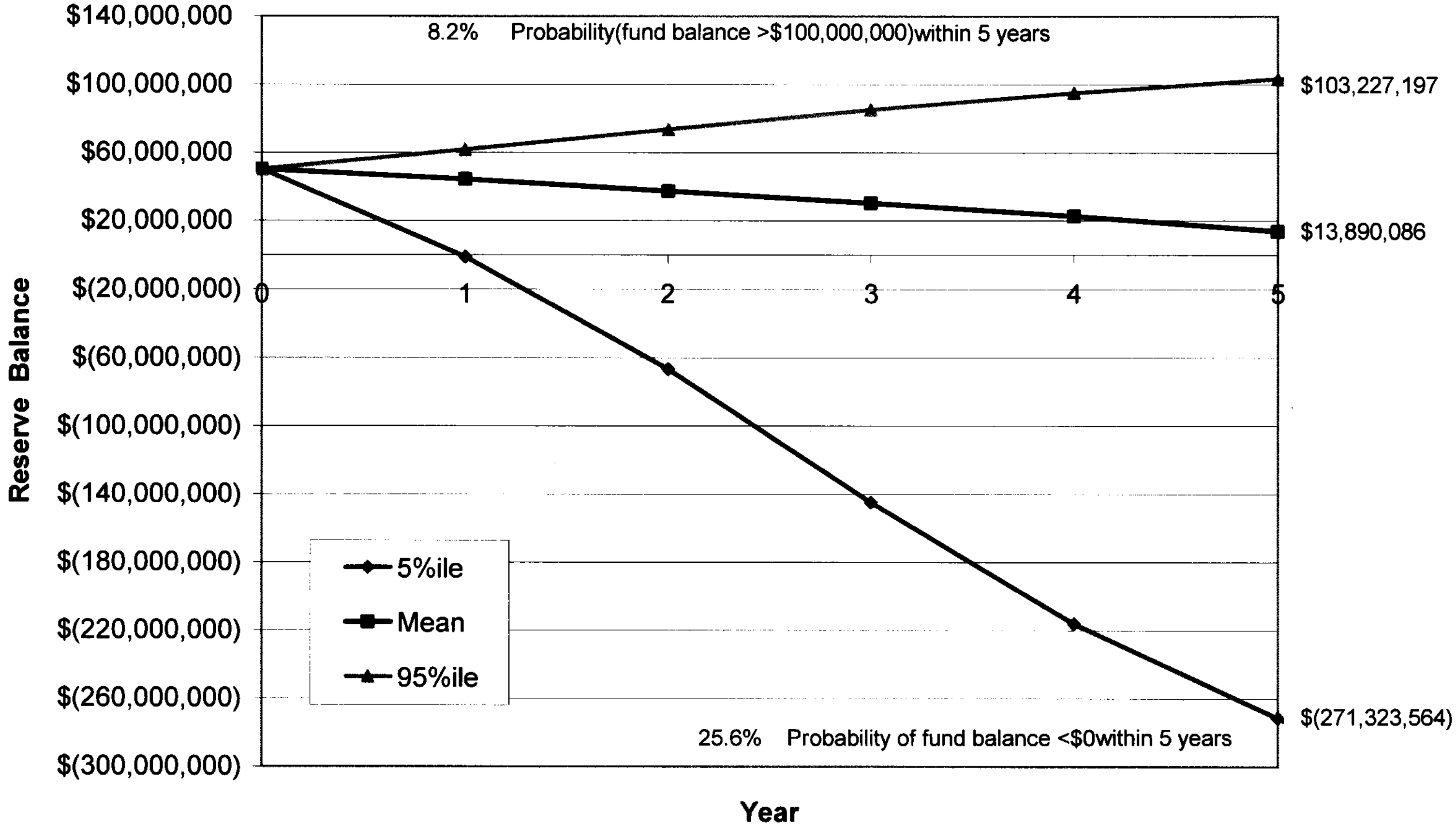


Figure 5-2: $50.2 million initial balance, $12 million annual accrual

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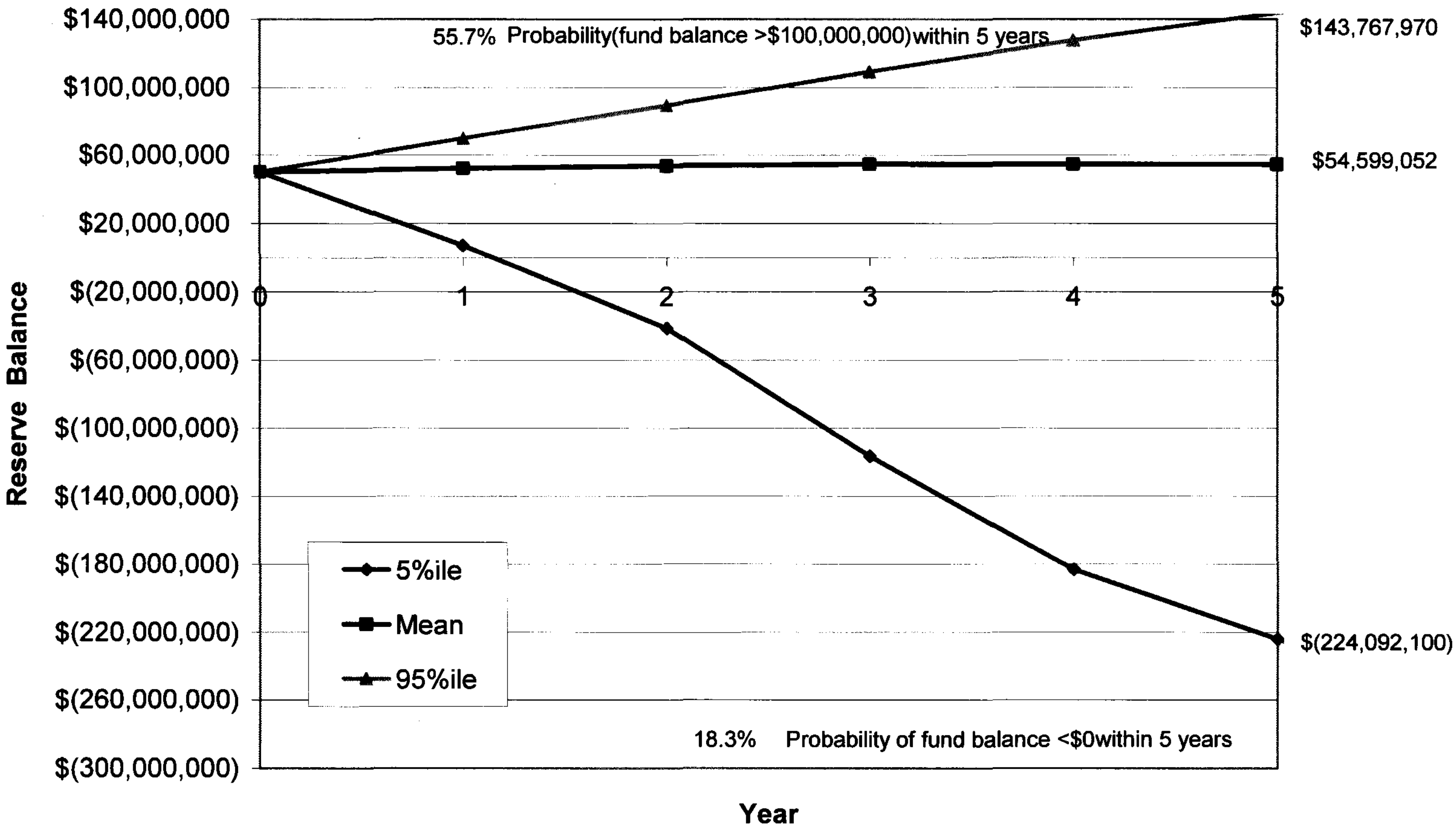


Figure 5-3: $50.2 million initial balance, $20 million annual accrual

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1. "Florida Commission on Hurricane Loss Projection Methodology", EQECAT, an ABS Group Company, May 17, 2011.

EQECAT
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