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April 9, 2021

ELECTRONIC FILING

Mr. Adam J. Teitzman, Commission Clerk
Office of Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850

Re: Docket 20210034-EI, Petition for Rate Increase by Tampa Electric Company

Dear Mr. Teitzman:

Attached for filing on behalf of Tampa Electric Company in the above-referenced docket is the Direct Testimony and Exhibit of Steven P. Harris.

Thank you for your assistance in connection with this matter.

(Document 20 of 34)

Sincerely,

J. Jeffry Wahlen

JJW/ne
Attachment

cc: Richard Gentry, Public Counsel
Jon Moyle, FIPUG

BEFORE THE
FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 20210034-EI
IN RE: TAMPA ELECTRIC COMPANY'S
PETITION FOR AN INCREASE IN BASE RATES
AND MISCELLANEOUS SERVICE CHARGES

DIRECT TESTIMONY AND EXHIBIT

OF

STEVEN P. HARRIS

ON BEHALF OF TAMPA ELECTRIC COMPANY

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. ABSG Consulting, Inc. (“ABS Consulting”), 300 Commerce Drive Suite 150, Irvine, California 92602.

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

A. I am a Senior Consultant with ABS Consulting, a subsidiary of the ABS Group of Companies. I was formerly with EQECAT (an ABS Group Company), which was acquired by CoreLogic, Inc. Insurance & Spatial Services, Consulting Services Group in December 2013.

ABS Consulting is a global provider of catastrophic risk management services to insurers, corporations, governments, and financial institutions.

Q. Please summarize your educational background.

A. I received bachelor’s and master’s Degrees in engineering from the University of California at Berkeley. I am a licensed civil engineer in the State of California.

Q. Please describe your responsibilities as a Senior Consultant with ABS Consulting.

A. As a Senior Consultant with ABS Consulting, I provide catastrophic risk management consulting services to major insurers, reinsurers, corporations, government, and other financial institutions. These services provide catastrophic underwriting, pricing, risk management, and risk transfer model analytics that are used extensively in the insurance industry. These services provide the financial, insurance, and brokerage communities with a science and technology-based source of independent quantitative risk information.

Q. Please describe your prior work experience and responsibilities.

A. 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.

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, Duke Energy Florida, Gulf Power Company, and others. Additionally, I have performed loss analyses for earthquake hazard for utilities including the Metropolitan Water District of Southern California, the Los Angeles Department of Water and Power, and the Sacramento Municipal Utility District.

For energy companies that have assets in a wide array of geographic locations, I have performed or supervised multi-peril analyses of transmission and distribution ("T&D") systems, power plants, solar farms, battery energy storage systems, and wind farms for natural hazards, including earthquakes, windstorms, and ice storms.

Q. Have you previously testified before this commission or other state public utility commissions?

A. Yes. I have submitted written testimony or testified before the Florida Public Service Commission ("FPSC" or "Commission") many times over the past 20 years. I have represented the Florida investor-owned utilities, including Tampa Electric, regarding T&D loss assessment and reserve coverage in each of these cases.

Q. What is the purpose of your direct testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to present the results of ABS Consulting's independent analyses of the risk of uninsured hurricane loss to Tampa Electric's T&D assets. The study includes a Hurricane Loss Analysis and a Reserve Performance Analysis.

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, "Hurricane Loss and Reserve Performance Analysis".

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

A. ABS Consulting performed two analyses relative to the reserve: The Hurricane Loss Analysis (“Loss Analysis”) and The Reserve Performance Analysis (“Reserve Analysis”). The Loss Analysis is a probabilistic hurricane analysis that uses proprietary software to develop an estimate of the expected annual amount of uninsured hurricane losses to which Tampa Electric is exposed. The Reserve 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.

Q. Please summarize the results of your analyses.

A. The Hurricane Loss Analysis estimated the level of annual damage that Tampa Electric is exposed to from hurricanes. The Reserve Analysis tested the performance of the reserve against the potential hurricane losses determined from the Loss Analysis. The study estimated the total expected average annual uninsured cost to Tampa Electric from all hurricanes to be $27.3 million.

The Reserve Analysis demonstrated that the expected reserve balance would be a deficit of negative $21.4 million at year five of the simulation, with a probability of a negative reserve balance of 70.1 percent within the five-year simulation time horizon.

LOSS ANALYSIS

Q. Please summarize the Loss Analysis.

A. The Loss Analysis determined the expected annual amount of hurricane losses to Tampa Electric’s T&D system. Hurricane losses included costs associated with service restoration and repair of Tampa Electric’s T&D system due to hurricanes. Also included are estimates of the costs of hurricane insurance deductibles attributable to non-T&D assets.

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

A. Risk Quantification and Engineering (“RQE®”) is a probabilistic catastrophe simulation model designed to estimate damage due to the occurrence of hurricanes. The model computes probabilistic annual damage using the results of thousands of random variable hurricanes and develops annual damage estimates for assets and aggregates them to produce the overall portfolio damage amounts. RQE’s climatological models are based on the National Oceanic and Atmospheric Administration's ("NOAA") National Weather Service ("NWS") Technical Reports. The RQE proprietary computer software model was evaluated and determined acceptable by the Florida Commission on Hurricane Loss Projection Methodology for projecting hurricane loss costs.

Q. Why are catastrophe simulation models used for hurricane loss projection?

A. Catastrophe simulation modeling is the process of using computer-assisted calculations to estimate the damage that could be sustained due to natural disasters such as hurricane events. Catastrophe simulation modeling combines actuarial science, engineering, meteorology, and computer science to allow loss estimation of infrequent events. The insurance industry and risk managers use catastrophe simulation modeling to assess and manage risks. Catastrophe simulation modeling is the current standard of risk assessment in the insurance industry.

Q. Does RQE take into account storm frequency and severity?

A. Yes. The analysis is based on storm frequency and severity distributions developed from the entire, over 100-year, historical hurricane record. RQE estimates the 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 over 100-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. The length of these active periods is thought to be about 25 to 40 years or more. 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 simulated hurricane events ABS Consulting 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 years 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. RQE includes the possibility of having multiple hurricane landfalls within Florida in any given year, including the impact of such landfalls on aggregate losses, similar to the 2004 hurricane season when multiple landfalls in Florida occurred.

Q. What were the results of the Loss Analysis?

A. The total expected annual uninsured cost to Tampa Electric’s system from all hurricanes is estimated to be

$27.3 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 hurricanes 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 is 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 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 additional costs are not reflected in ABS Consulting's analyses and results.

RESERVE PERFORMANCE ANALYSIS

Q. Please summarize the Reserve Analysis.

A. ABS Consulting performed a dynamic financial simulation analysis of the impact of the estimated hurricane losses on the reserve for specified fund parameters. The starting assumption for the Reserve Analysis was a reserve balance of $48.2 million. The Reserve Analysis includes 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.

This analysis technique relies on repeated sampling to model multiple storm seasons and simulates variable hurricane losses consistent with the results of the Loss Analysis. The study includes 10,000 five-year simulations to estimate the performance of the reserve and ensure an adequate number of samples of rare storm events because storm seasons and losses are highly variable. ABS Consulting used these Monte Carlo simulations to generate damage samples for the analysis.

ABS Consulting used the simulations to generate loss samples consistent with the expected annual loss from the Loss Analysis results. The expected annual loss determined in the Loss Analysis is $27.3 million, and $23.7 million of this amount 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 losses, using a financial model.

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

A. ABS Consulting used the likelihoods and amounts of uninsured annual losses determined in the Loss Analysis to simulate losses in each of the five years in the Reserve Analysis to determine the reserve balance and the likelihood of the reserve having positive balances.

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

A. The initial reserve balance is $48.2 million. The analysis also assumed future growth of the customer base and system assets and inflationary cost increases for new T&D assets of 3.96 percent annually.

Based on the simulated hurricane loss distributions, the expected or mean reserve balance is a negative $21.4

million. There is also a 70.1 percent chance of the reserve balance reserve reaching zero or becoming negative in one or more years of the five-year simulation.

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 reserve balance is a negative $137.8 million due to losses that would far exceed the reserve funds available. Conversely, the ninety-fifth percentile balance represents 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. Please summarize the results of your analyses.

A. The Loss Analysis demonstrated that the total expected annual damage to Tampa Electric’s system from all hurricanes is estimated to be $27.3 million.

The Reserve Analysis demonstrated that, assuming a $48.2 million initial reserve balance, and recovery of negative reserve balances due to storm losses over the following one-year period, the expected reserve balance would be a negative $21.4 million, and there would be a 70.1 percent probability of the reserve balance reaching zero or becoming negative in one or more years of the five-year simulation.

The $48.2 million reserve and one-year recovery of negative reserve balances are insufficient to pay for all the expected annual storm damage over the five-year period. Over the five-year simulation, the reserve balance would be expected to decline and have a negative balance.

Q. Does this conclude your direct testimony?

A. Yes.

EXHIBIT

OF

STEVEN P. HARRIS

ON BEHALF OF TAMPA ELECTRIC COMPANY

Table of Contents

TECO ENERGY
AN EMERA COMPANY

Tampa Electric Company

Hurricane Loss and Reserve Performance Analysis

March 2021

ABS Consulting Project Number: 4486834

300 Commerce Drive, Suite 150 • Irvine, CA 92602, USA • (714) 734-4242 • FAX (714) 734-4272

Executive Summary

Tampa Electric Company (TECO) transmission and distribution (T&D) systems are exposed to and in the past have sustained damage from hurricanes. The exposure of these assets to hurricane damage is described, and potential losses are quantified.

Two analyses were performed. A Hurricane Loss Analysis was performed using a computer catastrophe simulation model that estimates the average annual damage to T&D assets from hurricane perils. A Reserve Performance analysis was performed using a dynamic financial simulation model to estimate the performance of the reserve subject to the annual hurricane loss probabilities determined in the Loss Analysis.

The hurricane exposure is analyzed from a probabilistic approach. The model simulates a large number of hurricanes, covering the full range of potential characteristics, and determines their corresponding losses. Factors considered in the analysis include the location of TECO's T&D assets, the probability of hurricanes of different intensities and landfall points impacting those assets, the vulnerability of those assets to hurricane damage, and the costs to repair assets and restore electrical service.

The frequencies and computed damage for a large set of simulated hurricanes are combined to calculate the expected annual loss and the annual aggregate exceedance relations. The expected annual damage represents the average of all hurricane years over a long period of time.

There is a 10% probability that damage to T&D assets from all hurricanes in one year could exceed $83 million, and a 1% probability that damage could exceed $320 million.

The Reserve Performance analysis simulates the performance of TECO's reserve fund over a five-year prospective period and is based on the probabilistic losses and frequencies of occurrence of hurricanes as determined in the Loss Analysis. The analysis assumes that there is a one-year recovery of negative reserve balance due to hurricane losses.

This analysis shows the reserve fund negative balance is expected to decline from the initial $48.2 million to a negative $21.4 million at the end of five years. There is a 70.1% probability that the reserve could have inadequate funds to cover hurricane damage in one or more years of the five-year simulation.

A summary of the analyses performed of TECO's hurricane loss exposure and reserve performance are provided in the risk profile in Table E-1 below.

Table E-1

Tampa Electric Company Risk Profile

OWNER	**Tampa Electric Company**	
ASSETS	Transmission and distribution (T&D) system consisting of: transmission towers, and conductors; distribution poles, transformers, conductors, lighting and other miscellaneous assets.	
LOCATION	All T&D assets located within State of Florida	
ASSET VALUE	Normal T&D replacement value is estimated to be approximately $5,000 million, of which approximately 16% is transmission and 84% is distribution.	
LOSS PERILS	Hurricanes, Category 1 to 5, and Deductible losses to insured general property.	
Hurricane Loss Analyses		
EXPECTED ANNUAL LOSS	$27.3 million	
1% AGGREGATE DAMAGE EXCEEDANCE VALUE	$320 million	
Reserve Performance Analyses		
$48.2 million initial balance	Mean (Expected) Balance at 5 years	5th Percentile Balance at 5 years
One (1) year recovery of Negative Reserve Balances	Negative $21.4 million	Negative $138 million

Table of Contents

1. Hurricane Loss Analysis

TECO transmission and distribution (T&D) systems are exposed to and in the past have sustained damage from hurricanes. The exposure of these assets to hurricane damage is described and potential losses are quantified. Loss analyses were performed using CoreLogic's computer model simulation program *Risk, Quantification and Engineering (RQE®)* and the asset portfolio data provided by TECO.

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. Damage to T&D assets is defined as the cost associated with repair and/or replacement of T&D assets, and to promptly restore service in a post hurricane environment. This cost is typically larger than the costs associated with scheduled repair and replacement.

Probabilistic Annual Damage & Loss is computed using the results of over 110,000 storm events. Annual damage and loss estimates are developed for each simulated storm and damage at asset individual sites and aggregated to provide overall portfolio damage and loss amounts.

Factors considered in the analyses of the T&D assets include the location of TECO's aerial 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.

Loss Estimation Methodology

The basic components of the hurricane risk analysis include:

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

These analysis components are summarized herein.

2. Assets at Risk

2.1 Transmission and Distribution Assets

TECO's T&D System assets consist of:

- Transmission towers and conductors,
- Distribution poles and transformers,
- Conductors and lighting
- Other miscellaneous assets.

The total normal replacement value of TECO's T&D assets is approximately $5,000 million, 16% of which is transmission and 84% distribution. Normal replacement value is the cost of replacing the assets under normal non-catastrophe conditions.

TECO's T&D assets are distributed unevenly across their Florida service territory. These assets are geo-located in the RQE hurricane model by latitude and longitude to capture the spatial distribution and concentration of these assets at risk.

Figure 2-1 shows a map of TECO's aerial distribution values, and Figure 2-2 shows a map of the aerial transmission values.

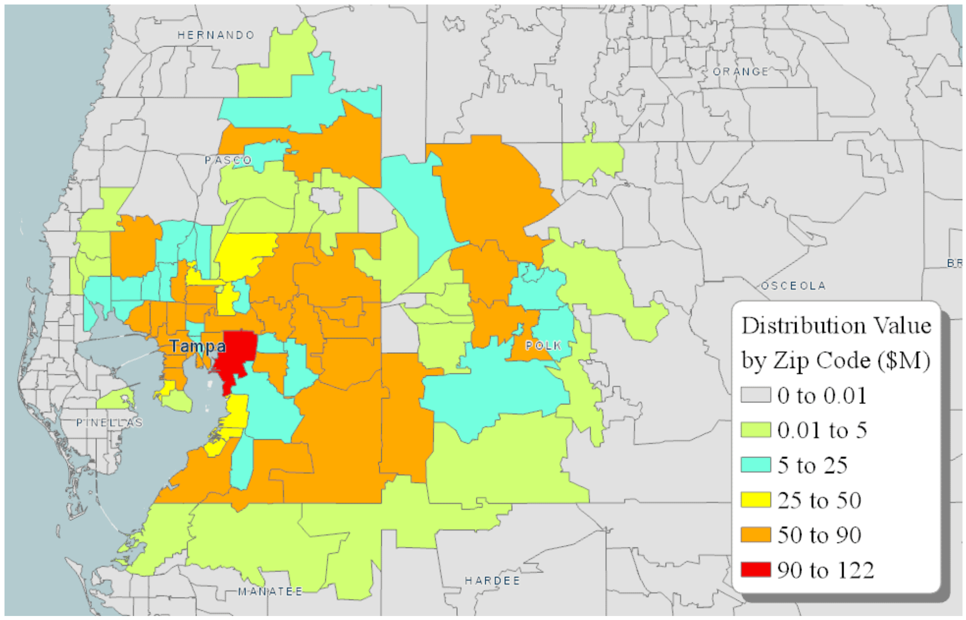

Figure 2-1: TECO Aerial Distribution Asset Values by Zip Code

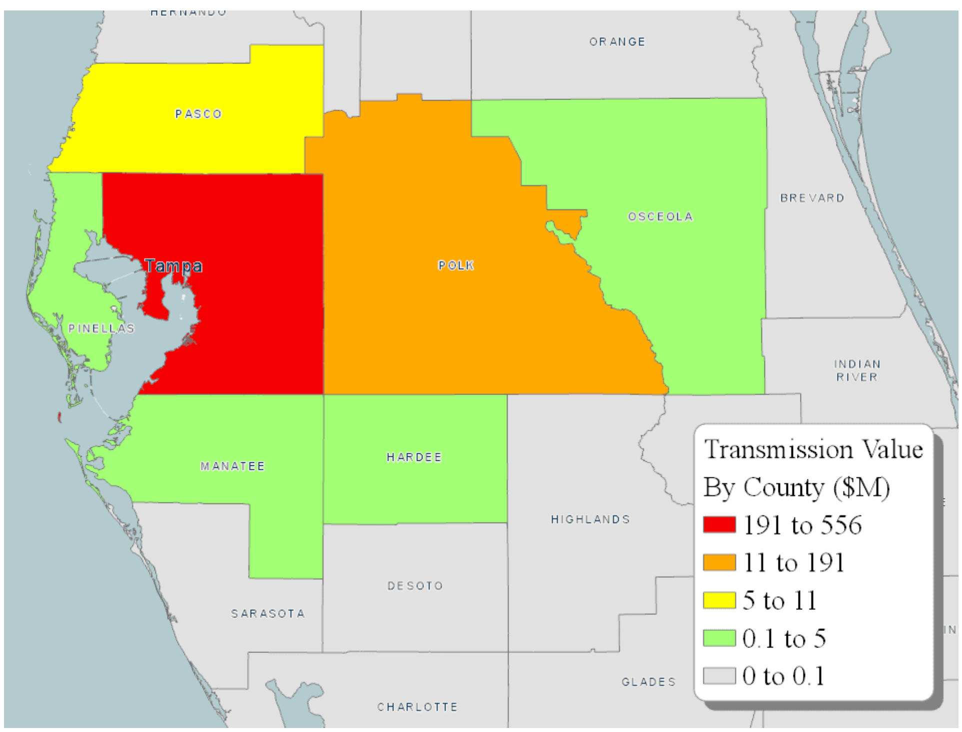

Figure 2-2: TECO Aerial Transmission Asset Values by County

3. Hurricane Hazard in Florida

The historical record for hurricanes on the Gulf and Atlantic coasts of the United States consists of over 100 years for which reasonably accurate information is available. Historically, approximately 500 tropical or subtropical cyclones have affected the state of Florida. Since 1900, there have been 29 hurricanes of Saffir-Simpson Intensity (SSI) 3 or greater (see Table 3-1 for description of the Saffir-Simpson Intensity scale) which have made landfall in the state of Florida. Going back further, written descriptions of storms are available, but it becomes increasingly difficult to estimate actual storm intensities and track locations in a reliable manner consistent with the later data. For this reason, all hypothetical storms used in this analysis, as well as their corresponding frequencies, have been based only on hurricanes that have occurred since 1900.

Since the historical record is too sparse to simply extrapolate future hurricane landfall probabilities, a series of hypothetical storms were generated in the RQE probabilistic storm data base, essentially “filling in” the gaps in the historical data. This provides an estimate of future potential storm locations (landfall), track, severity, and frequency consistent with the observed historical data.

The hurricane model was developed (Reference 1), using the National Oceanic and Atmospheric Administration (NOAA) model as the base, to determine individual storm wind speeds. The NOAA model was designed to model only a few specific types of storms. While the eye of the hurricane follows the selected track, the model uses up to a dozen different storm parameters to estimate wind speeds at all distances away from the eye. RQE is based in part on the Florida Commission on Hurricane Loss Projection Methodology’s Official Storm Set, which includes hurricanes affecting Florida during the period 1900 through 2017.

The hurricane intensities used for the analyses conform to basic NOAA information regarding hurricane intensity recurrence relationships corresponding to locations along the coast. TECO’s service territory includes coastal areas where these hurricanes have made landfall.

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 basins 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 present, 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 Present	Warm	(Increased Hurricane Activity)

These AMO phases are illustrated by the plot of Sea Surface Temperature (SST) Anomalies (deviation from the mean) in the Atlantic Basin over the past 150 years in Figure 3-1.

The National Oceanic and Atmospheric Administration (NOAA) believes that we entered a warm phase of AMO around the mid-1990s which can be expected to continue for at least several years. Historically, each phase of AMO has lasted approximately 20 to 40 years.

Probabilistic Annual Damage & Loss is computed using the results of thousands of random variable hurricanes considering the current near-term warm period of hurricane hazard.

Table 3-1

The Saffir-Simpson Intensity Scale (SSI)
(Note That Windspeeds Given Are 1-Minute Sustained)

SSI	Central Pressure (mb)	Maximum Sustained Winds (mph)	Storm-Surge Height (ft)	Damage
1	≥ 980	74-95	4-5	Damage mainly to trees, shrubbery, and unanchored mobile homes
2	965-979	96-110	6-8	Some trees blown down; major damage to exposed mobile homes; some damage to roofs of buildings
3	945-964	111-130	9-12	Foliage removed from trees; large trees blown down; mobile homes destroyed; some structural damage to small buildings
4	920-944	131-155	13-18	All signs blown down; extensive damage to roofs, windows, and doors; complete destruction of mobile homes; flooding inland as far as 6 mi.; major damage to lower floors of structures near shore
5	< 920	> 155	> 18	Severe damage to windows and doors; extensive damage to roofs of homes and industrial buildings; small buildings overturned and blown away; major damage to lower floors of all structures less than 15 ft. above sea level within 500m of shore

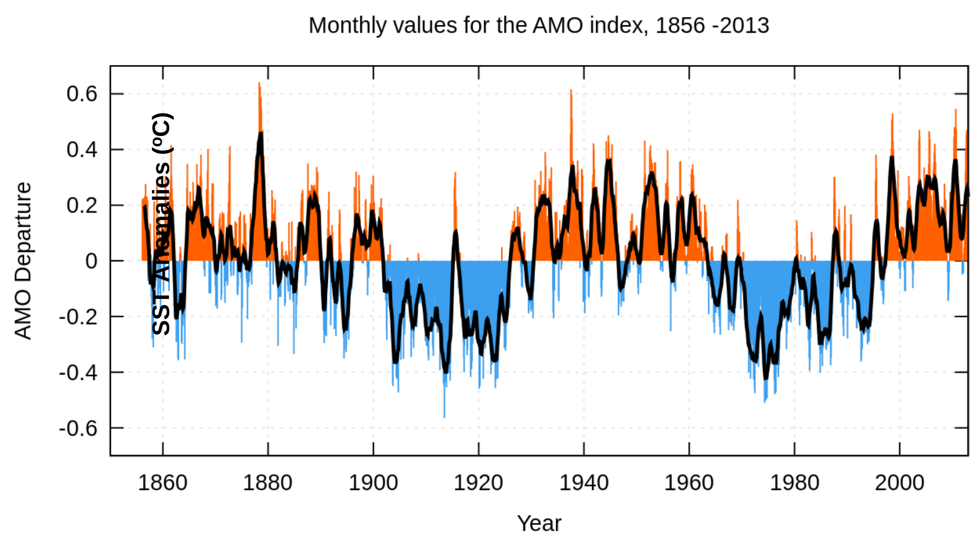

Figure 3-1: Atlantic Multidecadal Oscillation index computed as the linear detrended North Atlantic sea surface temperature anomalies, 1856-2013.

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4. Asset Vulnerabilities

Aerial T&D lines and structures have suffered damage in past hurricanes. Damage patterns tend to be most severe in coastal areas. Damage to inland aerial lines tends to be less severe with greater contributions to damage from wind-borne debris. The types of wind-borne debris include tree and tree limbs, and roofing materials as well as structure debris at higher wind speeds.

Vulnerability of T&D assets are based upon modeled wind speeds, and TECO provided storm cost data from hurricanes since 2004. The TECO loss history from the 2004 Hurricanes Frances, Jeanne, and Charley, and 2016 and 2017 Hurricanes Matthew and Irma provides data on recent hurricane recovery costs. These hurricane loss experiences include the effects of many factors including the post hurricane costs of labor, mutual aid and other factors associated with the hurricane restoration process utilized by TECO.

The TECO Storm Hardening program has hardened portions of the transmission and distribution system assets and facilities. The effects of the Storm Hardening program have also been factored into the expected damage to the system T&D assets in the Reserve Performance analysis over the next five-year period.

5. Hurricane Loss Analysis Results

TECO's portfolio of T&D assets was analyzed using the proprietary computer program, RQE subject to a suite of probabilistic hurricanes. The probabilistic storm analyses provide the expected annual damage and non-exceedance probabilities over a range of loss levels.

5.1 Storm Probabilistic Analysis

The probabilistic loss analysis is performed using RQE. The hurricane hazard uses the RQE probabilistic stochastic storm database that contains approximately 110,000 simulations of possible hurricanes affecting the eastern United States, along both the Gulf and the Atlantic coasts. Each hurricane in the database has been defined by associating a central pressure with a unique storm track. In addition, each hurricane is assigned an annual frequency of occurrence, which depends on the storm track location and the storm intensity as measured by central pressure. For each location in the portfolio, the wind speed is calculated, and based on the type of asset, the degree of damage is estimated. The sum of the damage for each asset location is an estimate of the mean damage for each hurricane simulation.

Aggregate Loss Exceedance and Expected Annual Loss

Aggregate damage exceedance calculations are developed by keeping a running total of damage from ***all possible events*** in a year. At the end of each 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 TECO's assets and the computer program RQE. A summary of the analysis is presented in Table 5-1, which shows the aggregate loss exceedance probability for damage layers between zero and over $325 million dollars.

For each damage layer shown, the probability of damage exceeding a specified value is shown. For example, the probabilities of losses exceeding $25 million in one year are 26.6%. The analysis calculates the probability of damage to T&D assets from all hurricanes and aggregates the total damage and exceedance probabilities.

The expected annual loss (EAL) hurricane damage to transmission and distribution is $27.3 million. This value represents the average loss from all simulated hurricanes. The EAL is not expected to occur each and every year. Some years will have no damage from hurricanes, 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 hurricane years over a long period of time.

Table 5-1

TECO T&D ASSETS
AGGREGATE LOSS EXCEEDANCE PROBABILITIES

Damage Layer ($ x 1,000)	1 Year Exceedance Probability
> 1,000	43.5%
25,000	26.6%
50,000	19.3%
75,000	12.4%
100,000	6.7%
125,000	4.2%
150,000	3.0%
175,000	2.3%
200,000	1.9%
225,000	1.7%
250,000	1.5%
275,000	1.3%
300,000	1.1%
325,000	0.98%

6. Reserve Performance Analysis

A dynamic financial analysis of potential losses from hurricanes was performed to determine their impact on the performance of TECO's reserve. The analysis included T&D losses from hurricanes, and insurance deductibles.

The expected annual loss from the Hurricane Loss Analysis is $27.3 million. The portion of the expected annual loss that was assumed to be an obligation of the reserve performance is $23.7 million. The $23.7 million total reflects the historical portion of non-capital storm costs that have been charged to the reserve, and an estimate of the restoration cost reductions due to the Storm Hardening program over the five-year simulation period.

The expected annual loss estimate represents the average annual cost associated with repair of hurricane damage and service restoration over a long period of time.

Analysis

The Reserve Performance analysis consisted of performing 10,000 iterations of hurricane loss simulations within the TECO service area, each covering a 5-year period, to determine the effect of the charges for damage on the TECO 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 hurricane damage, and borrowing costs when fund balances are negative, using a dynamic financial model.

Assumptions

The analysis performed included the following assumptions:

- An initial Reserve balance of $48.2 million.
- The Expected Annual Damage from storm hazard is $27.3 million, of which $23.7 million was an obligation to the reserve.
- A one (1) year recovery period for negative reserve balances from losses.
- Hurricane losses are assumed to increase by 3.96% per year as replacement values of T&D increase due to inflation, and system growth.

- Negative reserve balances are assumed to be financed with an unlimited line of credit costing 2.5%.
- Hurricane losses include estimates of property insurance policy deductibles of $25 million per occurrence.

Analysis Results

The analysis results for the case analyzed are shown in Figure 6-1 below. The results show the mean (expected) reserve fund balance as well as the probability that the reserve fund balance will be negative in any one or more of the five years of the simulated time horizon.

The reserve has a mean (expected) balance of negative $21.4 million at the end of the five-year simulation. The 5th percentile and 95th percentile five-year ending reserve balances are a negative $138 million and $47.5 million, respectively.

DOCKET NO. 20210034-EI
EXHIBIT NO. SPH-1
WITNESS: HARRIS
DOCUMENT NO. 1
PAGE 17 OF 19
FILED: 04/09/2021

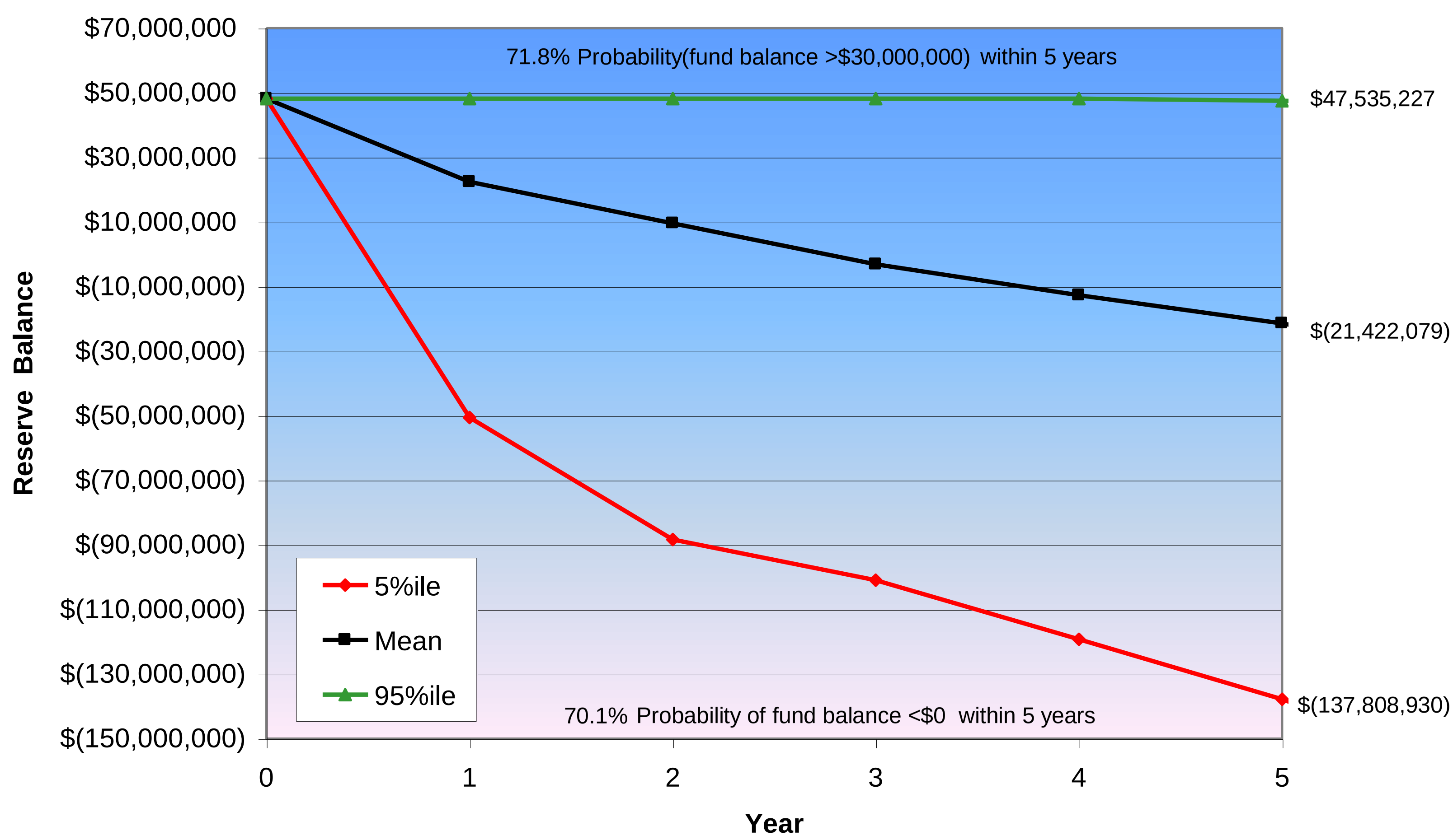

Figure 6-1: Reserve Performance Analysis: $48.2 million Initial Balance, and One-Year Recovery of Negative Balances

7. References

1. “Florida Commission on Hurricane Loss Projection Methodology”, CoreLogic North Atlantic Hurricane Model in Risk Quantification and Engineering™ November 2018 Submission, March 12, 2019 Revision”

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