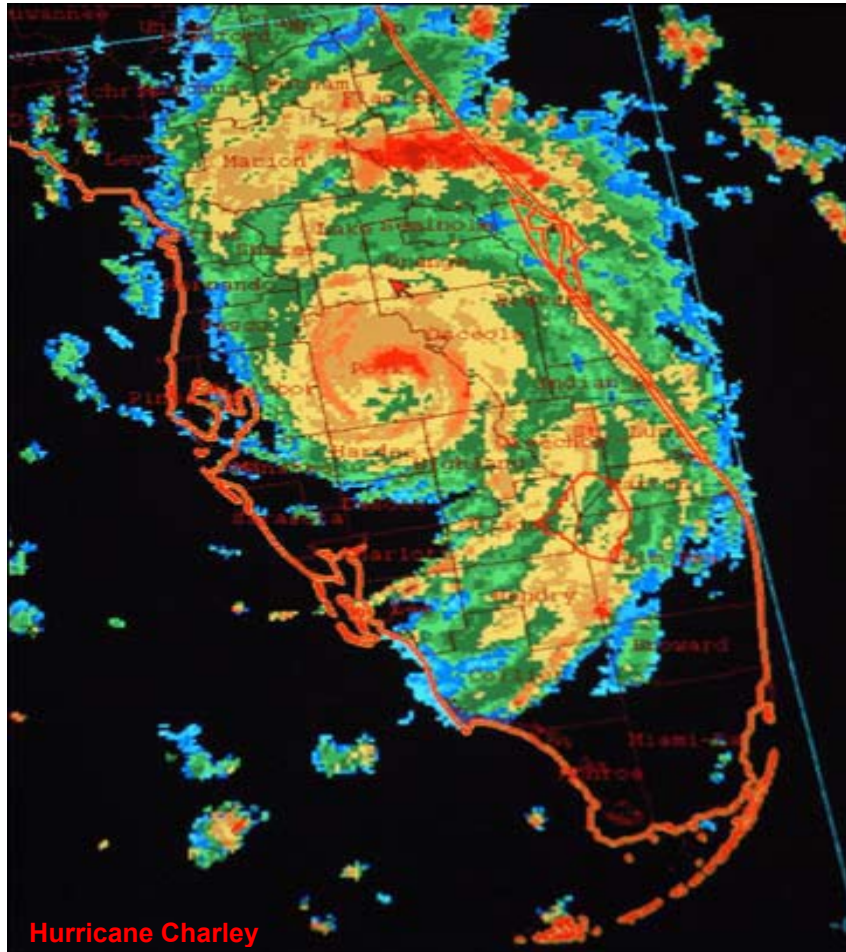


# Florida Commission on Hurricane Loss Projection Methodology



## Professional Team Report 2004 Standards

**EQECAT, Inc.**

On-Site Review  
April 4 – 6, 2005

On April 4 – 6, 2005, the Professional Team visited on-site at EQECAT, Inc. (EQE) in Oakland, California. The following people participated in the review.

**EQECAT**

Shawna S. Ackerman, FCAS, MAAA, Principal and Consulting Actuary – Pinnacle Actuarial Resources, Inc.

James R. (Bob) Bailey, Ph.D., P.E., Technical Manager, Wind Engineering Services (via telephone)

Branimir Betov, M.S., Senior Software Engineer

Richard Clinton, CPCU, President

Kent M. David, Senior Principal Engineer (Quality Assurance)

Petros G. Keshishian, Ph.D., Project Engineer

Mahmoud M. Khater, Ph.D., P.E., Senior Vice President, Chief Science and Technology Officer

Omar Khemici, Ph.D., P.E., Group Manager (Structural Engineering)

Thomas I. Larsen, Senior Vice President (Computer Science)

Sergey Pasternak, Senior Software Engineer

Krishnaraj Santhanam, Atmospheric Scientist

Anu Sandhu, Product Manager (Computer Science)

Nilesh Shome, Senior Project Engineer (Statistics)

David F. Smith, Group Manager (Meteorologist)

Pradeep Yalamanchi (Computer Science)

**Professional Team**

Jenni Evans, Ph.D., Meteorologist

Paul Fishwick, Ph.D., Computer Scientist

Mark Johnson, Ph.D., Statistician, Team Leader

Marty Simons, ACAS, Actuary

Nur Yazdani, Ph.D., P.E., Structural Engineer

Masoud Zadeh, Ph.D., P.E., Structural Engineer

Donna Sirmons, Staff

The review began with introductions and an overview of the audit process. EQE gave a presentation on the model changes since the February 2004 submission, namely:

- The probabilistic hurricane database was regenerated to be consistent with the Commission's November 1, 2004 hurricane set.
- The gradient to sustained conversion and air density parameter were updated to be consistent with current scientific literature and data.
- The distribution for hurricane frequency was changed from a Poisson to a negative binomial frequency.

Reviewed the effect of these changes on the statewide loss costs.

Discussed and reviewed the following corrections to be made in the submission that will be provided to the Commission prior to the June 1-3, 2005 meetings.

- Pages 24-26, G-2.2A revised to include new atmospheric meteorologist, Krishnaraj Santhanam and new computer scientist, Pradeep Yalamanchi.
- Page 26, G-2-2B revised to include new employees Anu Sandhu, Krishnaraj Santhanam, and Pradeep Yalamanchi

- Pages 36-41, Forms G-1 through G-6, revised with updated signatures following the revisions made to the original February 28, 2005 submission.
- Page 45, M-2.3, revised response to include reference for gradient to surface winds conversion.
- Page 48, M-3.1, revised response for consistency with handling of by-passing storms.
- Page 49, M-3.2, revised response for consistency with handling of by-passing storms.
- Page 50, M-4.1, revised to include references for HRD data used.
- Pages 52-53, M-5A, revised response for correct land friction database.
- Page 53, M-5.1 revised for correct statement on the decay parameter independence.
- Page 55, Figure 6 revised to plot range in mph.
- Page 58, Form M-1 revised for correct modeled frequencies for adjacent states.
- Pages 62-63, Form M-2, Figures 9 & 10, revised for consistency using the same land cover points.
- Pages 64-65, Form M-3 and Figure 11 revised using the full stochastic storm set rather than a reduced set and Figure 11 y-axis corrected for mph.
- Page 78, Form V-2, revised to provide explanation for 0.0 given for Roof Covering 8d nailing of deck, vertical reinforcing, and wall foundation anchors.
- Page 79, A-1.1, revised response for consistency with handling of by-passing storms.
- Page 119, Form A-4 revised for correct Elena loss costs
- Page 206, C-2.1, revised response moved statement on quality assurance documentation to appropriate Standard.
- Page 208, C-4.E, revised response to show compliance with comments requirement.

The above revisions are included in the revised submission received on 5/27/05.

Reviewed and discussed additional information EQE anticipates including in their presentation to the Commission at the June model review meetings.

## **Report on Deficiencies**

The Professional Team reviewed the following deficiencies cited by the Commission at the March 10 & 11, 2005 meetings. All deficiencies were corrected by the established time frame and have been verified. A copy of the revised submission pages, with the revisions made to the original submission highlighted, is enclosed with this report.

1. Response to standards. For a number of standards, there is no response given in support of compliance. Examples include G-2, M-1, A-1, A-9. The Report of Activities (page 33) states, “If a Standard or Disclosure has multiple sections, respond to each separately.” The following list of standards indicates standards for which responses are not given separately: M-4, M-6, V-1, V-2, A-2, A-3, A-5, A-6, A-7, A-8, C-1, C-4, C-5, C-6.

Revised pages submitted:

- Page 22, response provided in support of compliance with Standard G-2.
- Page 42, response provided in support of compliance with Standard M-1.
- Page 109, response provided in support of compliance with Standard A-9.
- Page 50, separate responses provided in support of compliance with each section of Standard M-4.
- Page 57, separate responses provided in support of compliance with each section of Standard M-6.
- Page 66, separate responses provided in support of compliance with each section of Standard V-1.
- Page 72, separate responses provided in support of compliance with each section of Standard V-2.
- Pages 80-81, separate responses provided in support of compliance with each section of Standard A-2.
- Page 83, separate responses provided in support of compliance with each section of Standard A-3.
- Pages 95-96, separate responses provided in support of compliance with each section of Standard A-5.
- Page 100, separate responses provided in support of compliance with each section of Standard A-6.
- Page 105, separate responses provided in support of compliance with each section of Standard A-7.
- Page 107, separate responses provided in support of compliance with each section of Standard A-8.
- Page 205, separate responses provided in support of compliance with each section of Standard C-1.
- Page 208, separate responses provided in support of compliance with each section of Standard C-4.
- Page 209, separate responses provided in support of compliance with each section of Standard C-5.
- Page 211, separate responses provided in support of compliance with each section of Standard C-6.

2. G-2. Disclosure 1.D. Pages 22-23. Percentages not given.

Revised page 23 submitted with percentages given.

3. G-2. Disclosure 2.B. Page 26. Anu Sandhu started in 2004 but is not listed as a new employee. There also appears to be some names not in last year's submission who are new to the project but not new employees.

Revised page 26 submitted with new employee, Anu Sandhu, provided in G-2.2B.

4. G-2. Disclosure 2.C. Page 27. Names missing from Figure 4.

Revised page 27 submitted with names of key personnel provided in Figure 4.

5. G-4. Page 34. Disclose the gust factor function. The Kraye and Marshall reference needs to be given on page 21, as it is evidently pertinent to the submission.

Revised page 21 submitted with the Kraye and Marshall reference added. Revised page 34 submitted with an explanation for not disclosing the gust factor function. The Professional Team reviewed the details of the gust factor function during the on-site review.

6. M-2. Disclosure 3. Page 45. Justify the spatial variation of the conversion factors. Cite a specific reference for the 0.863 factor.

Revised page 45 submitted with justification provided for the spatial variation of the conversion factors. The reference for the 0.863 factor was also included.

7. M-2. Disclosure 5. Page 45. Describe the approach rather than stating a reference.

Revised page 46 submitted with more details provided on how the asymmetric nature of hurricanes is considered in the model.

8. A-4. Disclosure 2. Page 86. Note final sentence of disclosure: "All items in the output form submitted to the Commission should be clearly labeled and *defined*." Define "Multiple Layer Flag" (pages 87-90) and "Global Limits/Deductibles" (page 90).

Revised page 86 submitted with an explanation of the terms "Multiple Layer Flag" and "Global Limits/Deductibles."

9. Form S-3. Page 202. Label for Figure 31 is not correct.

Revised page 202, Form S-3 submitted with correct label provided for Figure 31.

Revised pages 36-41, Forms G-1 through G-6, submitted with updated signatures after the above revisions were made to the original February 28, 2005 submission.

## GENERAL STANDARDS – Mark Johnson, Leader

### G-1 Scope of the Computer Model and Its Implementation

*The computer model shall project loss costs for personal lines residential property from hurricane events.*

#### Audit

1. The main intent of the audit is to determine the capabilities of the model and to assess its implementation for purposes of Florida projected loss costs. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.
2. Software located within the model, used to compile data used by the model, used to validate the model, and used to project model loss costs will be reviewed.
3. Databases or data files relevant to the modeler's submission will be reviewed.

#### Pre-Visit Letter

1. G-1.2, page 11 – We would like to review the 1 mile increment aspect noted.
2. G-1.2, page 13 – How do “storms of uniform intensity” and “storms of uniform recurrence levels” differ?
3. G-1.2, page 16 – Be prepared to discuss the empirical adjustment to the observed: gradient wind ratio to generalize the NWS equations for lower intensity storms.

**Verified: YES**

#### Professional Team Comments:

Reviewed the difference between “storms of uniform intensity” and “storms of uniform recurrence levels”.

Reviewed maps showing the results of selecting different increments for approaching hurricanes within a “x” mile radius and for different categories.

Reviewed pertinent aspects of the following technical papers that describe the underlying theory of the model:

- NWS-23
- NWS-38
- MacDonald-Mehta Engineers (1993). Vulnerability Functions for Estimating Wind Damage to Buildings, for EQE Engineering and Design, Texas Tech University, Lubbock, Texas.

- Scott, D.W. (1992). *Multivariate Density Estimation: Theory, Practice, and Visualization*, John Wiley and Sons, New York, NY.
- Simiu, E. and Scanlan, R. H. (1996). *Wind Effects on Structures*, John Wiley and Sons, New York, NY.

## **G-2 Qualifications of Modeler Personnel and Independent Experts**

***A. Model construction, testing, and evaluation shall be performed by modeler personnel or independent experts who possess the necessary skills, formal education, or experience to develop hurricane loss projection methodologies.***

***B. The model or any modifications to an accepted model shall be reviewed by either modeler personnel or independent experts in the following professional disciplines: structural/wind engineering (licensed Professional Engineer), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall be signatories on Forms G-1 through G-6 as applicable and shall abide by the standards of professional conduct if adopted by their profession.***

### **Audit**

1. The professional vitae of modeler personnel and independent experts responsible for the current model and information on their predecessors if different than current personnel will be reviewed. Background information on individuals providing testimonial letters in the submission shall be provided.
2. Forms G-1, G-2, G-3, G-4, G-5, G-6, and all independent peer reviews of the model will be reviewed.
3. Discuss any incidents where modeler personnel have been found to have failed to abide by the standards of professional conduct adopted by their profession.

### **Pre-Visit Letter**

4. G-2.1.A, page 22 – Describe the relationship between EQE and the ABS Group.
5. G-2.3.A, page 28 – What aspects of the independent reviews from Friedman, Mehta, McDonald, Cornell, Orts and Walrad are relevant to the current revision?
6. G-2.3.B, pages 29-30 – Clarify the intended contents of the Appendix or Appendices.

**Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received**

## Professional Team Comments:

Reviewed resumes of new modeler personnel:

- Krishnaraj Santhanam, Ph.D., Meteorology, Saint Louis University; Master's of Technology in Atmospheric Sciences, Cochin University of Science and Technology, India; Master's of Science in Mathematics, Loyola College, Madras, India
- Anu Sandhu, MBA, Marketing and Finance, Symbiosis Institute of Management Studies, Pune, India; B. Com, Finance, Jesus and Mary College, University of Delhi, New Delhi, India
- Pradeep Yalamanchi, Master of Information Systems Management, Carnegie Mellon University, Pittsburgh, PA; Bachelor of Electronics and Communications Engineering, Anna University, Chennai, India

Reviewed EQE's affiliation with the ABS Group and the history of the ABS Group.

Reviewed the independent peer reviews of the model and their relevancy to the current submission.

- Vulnerability Functions for Estimating Wind Damage to Buildings, James R. McDonald, Ph.D., P.E. and Kishor C. Mehta, Ph.D., P.E. was determined to be a report EQE funded rather than a peer review letter.
- EQE Software Architecture, Assessment and Roadmap for the Future, September 24, 1998, Davenport Consulting (Daryl Orts and Chuck Walrad)
- Review of USWIND; Quick Mode, Richard W. Mensing, January 18, 1995
- Review of USWIND; Quick Mode, Dr. C. Allin Cornell, January 26, 1995

Revisions to be provided to the Commission:

- Forms G-1 through G-6
- Response to G-2.2A to include new atmospheric meteorologist, Krishnaraj Santhanam and new computer scientist, Pradeep Yalamanchi
- Response to G-2.2B to include new employees Anu Sandhu, Krishnaraj Santhanam, and Pradeep Yalamanchi

Revised responses to G-2.2.A and G-2.2.B, pages 24-26 received and reviewed by the Professional Team.

Revised Forms G-1 through G-6, pages 36-41 received and reviewed by the Professional Team.



### **G-3 Risk Location**

- A. ZIP Codes used in the model shall be updated at least every 24 months using information originating from the United States Postal Service. The United States Postal Service issue date of the updated information shall be reasonable.***
- B. ZIP Code centroids, when used in the model, shall be based on population data.***
- C. ZIP Code information purchased by the modeler shall be verified by the modeler for accuracy and appropriateness.***

### **Audit**

1. Provide geographic displays for all ZIP Codes. The location of specific centroids will be reviewed.
2. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.

**Verified: YES**

### **Professional Team Comments:**

Verified no changes were made in the ZIP Code database or the methodology for validation and incorporation of the data in the model.

Discussed the possibility of structure based exposures.

### **G-4 Units of Measurement**

- A. All units of measurement for model inputs and outputs shall be clearly identified.***
- B. All model outputs of length, wind speed, and pressure shall be in units of statute miles, statute miles per hour, and millibars, respectively.***
- C. Wind inputs to the damage function shall be in units consistent with currently used wind measurement units and/or shall be converted using standard meteorological/engineering conversion factors.***

## Audit

The appropriateness and accuracy of the measurements, conversion factors, and techniques will be reviewed.

**Verified:** ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

### Professional Team Comments:

Verified appropriate units of measurement throughout the review process.

- Revised page 55, Figure 6 to be provided to the Commission with plot range corrected for mph
- Revised page 65, Figure 11 to be provided to the Commission with y-axis corrected for mph

Revised Figure 6, page 55 and Figure 11, page 65 received and reviewed by the Professional Team.

Reviewed in detail the gust factor function.

## G-5 Independence of Model Components

*The meteorological, vulnerability, and actuarial components of the model shall each be theoretically sound without compensation for potential bias from the other two components. Relationships within the model among the meteorological, vulnerability, and actuarial components shall be reasonable.*

## Audit

1. Demonstrate that the model components adequately portray hurricane phenomena and effects (damage and loss costs). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model would not meet this Standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.
2. Describe all changes in the model since the previous submission that might impact the independence of the model components.

## Pre-Visit Letter

7. G-5, page 35 – How do the model changes maintain the independent validation of model components?

8. G-5, page 35 – Can the meteorological component also accommodate the duration of damaging winds?

**Verified: YES**

**Professional Team Comments:**

The independence of the meteorology, vulnerability, and actuarial components was verified and their theoretical soundness was discerned in the course of the review.

## **METEOROLOGICAL STANDARDS – Jenni Evans, Leader**

### **M-1 Official Hurricane Set\***

*(\*Significant Revision)*

***For landfall frequency analyses, the modeler shall use the latest updated Official Hurricane Set. Updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to the Official Hurricane Set. Additional information from the National Hurricane Center or from peer reviewed atmospheric science literature can be used to justify modifications to the Official Hurricane Set.***

### **Audit**

1. The modeler will provide the hurricane set used. Failure to update the hurricane set to the most recent year is not acceptable. For revisions to HURDAT, only complete incremental revisions are acceptable.
2. The additional information from the National Hurricane Center or from peer reviewed atmospheric science literature will be reviewed.

**Verified: YES**

**Professional Team Comments:**

Verified that the probabilistic hurricane database was updated through the 2003 hurricane season.

## **M-2 Hurricane Characteristics\***

*(\*Significant Revision)*

***Methods for depicting all modeled hurricane characteristics, including but not limited to wind speed, radial distributions of wind and pressure, minimum central pressure, radius of maximum winds, strike probabilities, tracks, and the spatial and time variant wind fields, shall be based on information documented by currently accepted scientific literature or modeler information accepted by the Commission.***

### **Audit**

1. Identify all of the hurricane characteristics used in the model. For hurricane characteristics modeled as random variables describe the probability distributions used.
2. Prepare graphical depictions of hurricane characteristics as used in the model. Describe and justify:
  - the data set basis for the fitted distributions,
  - the modeled dependencies among correlated characteristics in the wind field component and how they are represented,
  - the asymmetric nature of hurricanes,
  - the fitting methods used and any smoothing techniques employed.
3. The goodness-of-fit of distributions to historical data will be reviewed.
4. The modeler will present time-based contour animations (capable of being paused) of wind and pressure fields to demonstrate scientifically reasonable wind field characteristics.
5. The treatment of uncertainties associated with the conversion of gradient winds to surface winds will be compared with currently accepted literature.
6. Map the location of the peak hurricane intensity compared to the western most point of a random selection of recurving storm tracks for hurricanes effecting Florida.
7. All modeler-specific scientific literature provided in Disclosure 9 will be reviewed to determine acceptability.

### **Pre-Visit Letter**

9. M-2.1, page 44 – Discuss why the profile factor is held fixed at a value of “1” for the stochastic storm set, rather than varying according to the historical dataset.
10. M-2.2, page 45 – Discuss the lack of relationship between  $R_{MAX}$  and other variables.
11. M-2.3, page 45 – How is the factor 0.863 derived?

12. M-2.6, page 46 – Be prepared to show the other scientifically accepted publications used in developing the model's hurricane tracks (as referenced).

**Verified:** ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

**Professional Team Comments:**

Reviewed the hurricane characteristics used in the model, their treatment, and the probability distribution used for the random variables.

Reviewed time-based contour animations of a model-derived wind field, verifying the asymmetric nature of the winds in a moving storm.

Reviewed in detail the profile factor used in the model, its calculation, and the basis and the process for determining the profile factor used. Reviewed the equation and the actual computer code. Reviewed the profile factor distribution data set for selected historical storm cases.

Reviewed the process for converting peak gust winds to 10-minute sustained winds to one-minute sustained 10-meter wind speeds and the conversion of gradient winds to surface level winds. Reviewed the 0.863 conversion factor used and the Simiu and Scanlan (1996) reference, Figure 2.3.10, as the basis for the conversion factor.

Reviewed the spatial variation in the gust winds at a site-specific level.

Reviewed the historical data used as the basis for the model's hurricane tracks.

Reviewed the relationship between Rmax and central pressure.

- NWS-38 updated through the 1998 hurricane season
- Scott, D.W. (1992), *Multivariate Density Estimation: Theory, Practice, and Visualization*

Reviewed map showing the location of peak winds for the Florida stochastic storm set and the recurvature point versus the location of maximum sustained winds.

Revised response to M-2.3 to include reference for the conversion of gradient to surface winds to be provided to the Commission.

Revised response to M-2.3, page 45 received and reviewed by the Professional Team.

### M-3 Landfall Intensity\*

(\*Significant Revision)

**Models shall use maximum one-minute sustained 10-meter wind speed when defining hurricane landfall intensity. This applies both to the Official Hurricane Set used to develop landfall strike probabilities as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter wind speed shall be within the range of wind speeds (in statute miles per hour) categorized by the Saffir-Simpson scale.**

**Saffir-Simpson Hurricane Scale:**

Category	Winds (mph)	Damage
1	74 - 95	Minimal
2	96 - 110	Moderate
3	111 - 130	Extensive
4	131 - 155	Extreme
5	Over 155	Catastrophic

### Audit

Demonstrate that the hurricane intensity at landfall is consistent with the Saffir-Simpson wind range for the stochastic storm set.

### Pre-Visit Letter

13. M-3.1, page 48 – Be prepared to discuss how the simulated hurricane tracks relate to the landfall frequencies and directions.

14. M-3.2, page 49 – Be prepared to discuss the event definition.

**Verified: YES, ~~Contingent upon additional documentation provided to the Commission~~ Additional documentation received**

### Professional Team Comments:

Reviewed graphical comparison of historical and modeled landfall frequencies by region. Revised Figure 8 will be provided to the Commission (see M-4).

Revised responses to M-3.1 and M-3.2 for consistency in handling by-passing storms to be provided to the Commission.

Revised responses to M-3.1 and M-3.2, page 48 & 49 received and reviewed by the Professional Team.

#### **M-4 Hurricane Probabilities\***

*(\*Significant Revision)*

- A. Modeled probability distributions for hurricane intensity, forward speed, radii for maximum winds, and landfall angle shall be consistent with historical hurricanes in the Atlantic basin.**
  
- B. Modeled hurricane probabilities shall reasonably reflect the Official Hurricane Set through 2003 for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).**

#### **Audit**

1. Probabilities are compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical hurricane frequencies for the four regions of Florida and overall as provided in Form M-1 will be reviewed.
2. Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.
3. Describe and support the method of selecting stochastic storm tracks and landfall angles.
4. Describe and support the method of selecting storm track strike intervals. If strike locations are on a discrete set, show the landfall points for major metropolitan areas in Florida.
5. Demonstrate the goodness-of-fit of distributions to historical hurricane characteristics.
6. Provide the source documents or any research performed to develop the functions used for simulating model variables or databases.

#### **Pre-Visit Letter**

17. Form M-1, page 60 – Discuss the uniform under-representation in the modeled storm set of (i) storms in the adjacent states (all but Cat 4) and (ii) Cat 5 hurricanes across all regions.

**Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received**

### **Professional Team Comments:**

Reviewed graphical representation of storm frequency in Florida using a negative binomial distribution. Reviewed comparisons of results using a negative binomial versus a Poisson distribution. Reviewed Kolmogorov-Smirnov and Chi-Square goodness-of-fit tests of landfall frequency by region and for adjacent states.

Reviewed the method used for selecting storm track strike intervals.

Reviewed probability distribution and Chi-Square tests of Rmax and forward speed comparing modeled versus historical showing the distribution fits.

Reviewed graph of selected storms comparing forward speed and the duration of winds.

Reviewed Form M-1, Annual Occurrence Rates and discussed discrepancies in the Official Hurricane Set. Due to an under-representation of storms in Mississippi, Alabama, and Georgia (except for Cat 4 storms) and an under-representation of cat 5 storms across all regions, EQE will be submitting a revised Form M-1 to the Commission prior to the June model review meetings.

Revised response to M-4.1 to include references for HRD data to be provided to the Commission.

Revised response to M-4.1, page 50 received and reviewed by the Professional Team.

### **M-5 Land Friction and Weakening**

***A. The magnitude of land friction coefficients shall be consistent with currently accepted scientific literature relevant to current geographic surface roughness distributions and shall be implemented with appropriate geographic information system data.***

***B. The hurricane overland weakening rate methodology used by the model shall be reasonable in comparison to historical records.***

### **Audit**

1. Identify other variables in the model that affect over land wind speed estimation.
2. Maps depicting land friction effects are required. Describe the representation of land friction effects in the model. Describe the variation in decay rate over land used in the model.
3. Comparisons of the model's weakening rates to historical Florida hurricanes and to weakening rates will be reviewed.



4. Transition of winds from over water to over land (i.e. landfall) will be reviewed.
5. Form M-2 will be reviewed.

### Pre-Visit Letter

15. M-5.B, page 53 – Justify the selection of storms used in developing the overland weakening rate.
16. M-5.4, page 55 – Explain the two values at landfall on Figure 6.
18. Form M-2, pages 62-63 – We would like to discuss the return period maps. There appears to be an interior island of higher winds than nearby coastal areas and some irregular shapes.

**Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received**

### Professional Team Comments:

Reviewed maps depicting the Florida water management district land use/land cover data. Reviewed the process for incorporating the land friction effects in the model.

Reviewed and discussed plots of the modeled decay rates compared to the Kaplan-DeMaria decay rate. Reviewed storm parameters used in constructing Figure 6. Viewed additional storm case for decay over land. Reviewed spatial distribution of peak gust wind speed.

Reviewed air density and sea surface temperature and their use in calculating the sustained winds.

Reviewed Form M-2 and discussed the inconsistencies between Figures 9 & 10.

Reviewed plot showing the relationship of DP and m and an example of filling.

Reviewed friction coefficient factors used in the land use/land cover process by category.

Response to M-5A revised to be consistent with the land use and land cover data provided in Disclosure 3 to be provided to the Commission.

Response to M-5.1 revised for correct statement on the decay parameter independence and a revised Form M-2, Figures 9 & 10, for consistency using the same land mask to be provided to the Commission.

Revised response to M-5.A, page 52 received and reviewed by the Professional Team.

Revised response to M-5.1, pages 53-54 received and reviewed by the Professional Team.

## **M-6 Logical Relationships of Hurricane Characteristics\***

*(\*Significant Revision due to Form M-3)*

- A. The radius of maximum winds shall reflect historical hurricane characteristics.**
- B. The magnitude of asymmetry shall increase as the translation speed increases, all other factors held constant.**
- C. The wind speed shall decrease with increasing surface roughness (friction), all other factors held constant.**

### **Audit**

Form M-3 and the modeler's sensitivity analyses provide the information used in auditing this Standard.

**Verified: YES, ~~Contingent upon additional documentation provided to the Commission~~ Additional documentation received**

### **Professional Team Comments:**

Verified all hurricane characteristics are treated in a logical manner in the model.

Reviewed in detail Form M-3 and Figure 11 and explanation of gaps visible in Figure 11.

Revised table for Form M-3 and Figure 11 using the full stochastic storm set rather than a reduced set and Figure 11 y-axis corrected for mph to be provided to the Commission.

Revised Form M-3 and Figure 11, pages 63 & 64 received and reviewed by the Professional Team.

## VULNERABILITY STANDARDS – Masoud Zadeh, Leader

### V-1 Derivation of Vulnerability Functions\*

(\*Significant Revision due to Form V-1)

- A. Development of the vulnerability functions is to be based on a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. Any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, or historical data.**
- B. The method of derivation of the vulnerability functions shall be theoretically sound.**
- C. Any modification factors/functions to the vulnerability functions or structural characteristics and their corresponding effects shall be clearly defined and be theoretically sound.**
- D. Construction type and construction characteristics shall be used in the derivation and application of vulnerability functions.**
- E. In the derivation and application of vulnerability functions, assumptions concerning building code revisions and building code enforcement shall be reasonable and be theoretically sound.**
- F. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and additional living expense.**
- G. The minimum wind speed that generates damage shall be reasonable.**

### Audit

1. Historical data should be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. To the extent that historical data are used to develop vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete structural calculations shall be presented so that a variety of different structure types and construction characteristics may be selected for review. The basis for expert opinion and original site inspection reports should be available for review.

2. Copies of any papers, reports, and studies used in the development of the vulnerability functions should be available for review. Copies of all public record documents used may be requested for review.
3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense should be available. The magnitude of logical changes among these items for a given wind speed shall be explained and validation materials should be available.
4. Justify the construction types and characteristics used, and provide validation of the range and direction of the variations in damage.
5. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement.
6. Provide validation material for the disclosed minimum wind speed. Provide the computer code showing the inclusion of the minimum wind speed at which damage occurs.
7. Describe how the duration of wind speeds at a particular location over the life of a hurricane is considered.
8. Form V-1 will be reviewed.

### **Pre-Visit Letter**

19. V-1, page 66 – Be prepared to discuss and show documents indicating how the vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense are derived.
20. V-1, page 66 – Provide the claims information since 1995 that has been used to maintain your confidence in the vulnerability function.
21. V-1, page 66 – Several recent hurricanes have been listed as post-disaster field survey sites. These include very recent 2004 hurricanes (Charley, Frances, Ivan and Jeanne). How do you intend to incorporate information on these storms in subsequent updates to the model or in further validations?
22. V-1.F, page 67 – Be prepared to show supporting documentation for derivation of loss functions for buildings, contents, and ALE.
23. V-1.1, page 68 – Claims data is shown as input in the model's vulnerability development flowchart. How is field survey and experimental data also used? What wind speeds were used and/or available.
24. V-1.7, page 71 – Be prepared to discuss the statement that “duration of wind speed is not considered”.

25. Form V-1, page 74 – Be prepared to disclose why the mobile home estimated damage in Form V-1 part B is substantially less in the 2004 submission than the 2003 submission.

**Verified: YES**

**Professional Team Comments:**

EQE provided a short overview of the history of the vulnerability functions. Reviewed the basis for the vulnerability functions.

Reviewed EQE's data validation process. Reviewed future plans to incorporate the information obtained from the most recent field surveys.

Reviewed plots of baseline vulnerability curves for building structures, contents, and additional living expenses showing % damage at various wind speeds. Reviewed examples of original curves. Reviewed steps in development of vulnerability curves including examples of regression curves, development of curves for strong and weak cladding.

Reviewed table of vulnerability function construction classes.

Reference documentation reviewed:

- Vulnerability Functions for Estimating Wind Damage to Buildings for EQE Engineering and Design, Texas Tech University, Lubbock, Texas, McDonald-Mehta Engineers, 1993.
- Project Safe Windows – Finding the Breaking Point, A Protecting People First Foundation Report, Documenting Window Performance in the 2004 Florida Hurricanes, February 7, 2005.

## **V-2 Mitigation Measures\***

*(\*Significant Revision due to Form V-2)*

**A. Modeling of mitigation measures to improve a structure's wind resistance and the corresponding effects on vulnerability shall be theoretically sound. These measures shall include fixtures or construction techniques that enhance:**

- **Roof strength**
- **Roof covering performance**
- **Roof-to-wall strength**
- **Wall-to-floor-to-foundation strength**
- **Opening protection**
- **Window, door, and skylight strength.**

**B. Application of mitigation measures shall be reasonable both individually and in combination.**

### **Audit**

1. Form V-2 provides the information used in auditing this Standard.
2. Total effect on damage due to use of multiple mitigation measures will be reviewed and shown to be reasonable. Any variation in the change over the range of wind speeds for individual and multiple mitigation measures will be reviewed and shown to be reasonable.
3. Mitigation measures used by the model that are not listed as required in this Standard will be disclosed and shown to be theoretically sound and reasonable.

### **Pre-Visit Letter**

26. Form V-2, pages 76-78 – We would like to review the results in this form. For example, what was used for shutters for mitigated structures?
27. Form V-2, page 78 – Why is there no beneficial effect of using 8d nails as opposed to using 6d nails on the roof sheathing? How about larger or closer spaced anchor bolts? Also, vertical reinforcing does not reduce damages in the masonry walls. Please explain.
28. Form V-2, page 78 – For the mitigated structure cell at the bottom of Form V-2 (structure), define which type of shutters are used.

**Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received**

### **Professional Team Comments:**

Reviewed Form V-2 in detail. Reviewed the relative values of various modification factors and their effect on overall building vulnerability.

Reviewed the basic methodology in developing the secondary modifier functions. Reviewed the modeler's set of Secondary Structural Modifiers: Features and Model Description, July 28, 2003 report and references.

Reviewed the secondary modifiers with examples, the ranking of the modifiers, the relative importance with respect to wind exposure, and the scoring of modifiers as applied to the vulnerability functions.

Revised Form V-2 to be provided to the Commission with an explanation for the resulting factors of "0.0" given for Roof Covering 8d nailing of deck, vertical reinforcing for masonry walls, and anchorage size and spacing.

Revised Form V-2, page 78 received and reviewed by the Professional Team.

## **ACTUARIAL STANDARDS – Marty Simons, Leader**

### **A-1 Modeled Loss Costs\***

*(\*New Standard)*

***Modeled loss costs shall reflect all damages starting when damage is first caused in Florida from an event modeled as a hurricane at that point in time and will include all subsequent damage in Florida from that event.***

***Any variations in modeled loss costs shall be justified.***

### **Audit**

1. The model will be reviewed to determine that the definition of an event in the model is consistent with Standard A-1.
2. The model will be reviewed to determine that by-passing storms and their effects are considered in a manner that is consistent with Standard A-1.

### **Pre-Visit Letter**

29. A-1, page 79 – Be prepared to describe how EQE estimates damage from bypassing storms. Include in the description, examples of storms that reach hurricane strength prior to or subsequent to causing damage in Florida and are not of hurricane strength when damage is

caused in Florida. This was a general issue broached at the March 10-11 Commission meeting.

30. A-1.1, page 79 – Describe how the loss costs are affected by storms that reach hurricane strength prior to or subsequent to causing damage in Florida and are not of hurricane strength when damage is caused in Florida.

**Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received**

**Professional Team Comments:**

Reviewed the definition of an event in the model and the handling of several different by-passing storms. For damage to be included, the event has to be defined as a hurricane at some point in its lifetime. Aspects of this discussion will be incorporated into the Professional Team report to the Commission.

Revised response to A-1.1 for consistency of handling by-passing storms to be provided to the Commission.

Revised response to A-1.1, page 79 received and reviewed by the Professional Team.

## **A-2 Underwriting Assumptions**

***A. When used in the modeling process or for verification purposes, adjustments, edits, inclusions, or deletions to insurance company input data used by the modeler shall be based upon accepted actuarial, underwriting, and statistical procedures.***

***B. For loss cost estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) claim payment practices, and (4) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be reasonable and appropriate.***

## **Audit**

Demonstrate how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify model calculations. For example, the level of damage the insurer considers a loss to be a “total loss.” Provide the methods used to delineate among the insurer claim practices in the use of historical claims data to verify model outputs.



## Pre-Visit Letter

31. A-2, page 80 – Provide any insurance data obtained since the prior review of the model by the FCHLPM.

**Verified: YES**

### Professional Team Comments:

Reviewed claims data collected, claim payment practices, and the process for reviewing the data before it is included in their analyses.

### A-3 Loss Cost Projections

- A. Loss cost projections produced by hurricane loss projection models shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.*
- B. Loss cost projections shall not make a prospective provision for economic inflation.*
- C. Loss cost projections shall not explicitly include demand surge.*

## Audit

1. Demonstrate how the presence of demand surge has been considered in any analysis where Hurricane Andrew losses are used for development or verification of the model or its output. Demonstrate how demand surge is considered in any other data used in the development or verification of the model.
2. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, and economic inflation.

**Verified: YES**

### Professional Team Comments:

Confirmed the actuarial review of the model and verified there has not been any model changes since the last actuarial review.

Reviewed Hurricane Andrew claims data used for model validation and adjustments made for demand surge. Reviewed comparative data for Andrew in relation to model output. Verified demand surge was not explicitly included in producing the loss costs.

## **A-4 User Inputs**

*All modifications, adjustments, assumptions, and defaults necessary to use the inputs in the model shall be actuarially sound and included with the model output. Treatment of missing values for user inputs required to run the model shall be actuarially sound and described with the model output.*

### **Audit**

1. Quality assurance procedures should include methods to assure accuracy of insurance data. Compliance with this Standard will be readily demonstrated through documented rules and procedures.
2. All insurer inputs and assumptions will be reviewed.

**Verified: YES**

### **Professional Team Comments:**

Reviewed sanity checks and rules applied when analyzing and verifying insurance claims data.

## **A-5 Logical Relationship to Risk**

- A. Loss costs shall not exhibit an illogical relation to risk, nor shall loss costs exhibit a significant change when the underlying risk does not change significantly.***
- B. Loss costs produced by the model shall be positive and non-zero for all valid Florida ZIP Codes.***
- C. Loss costs cannot increase as friction or roughness increase, all other factors held constant.***
- D. Loss costs cannot increase as the quality of construction type, materials and workmanship increases, all other factors held constant.***
- E. Loss costs cannot increase as the presence of fixtures or construction techniques designed for hazard mitigation increases, all other factors held constant.***
- F. Loss costs cannot increase as the quality of building codes and enforcement increases, all other factors held constant.***
- G. Loss costs shall decrease as deductibles increase, all other factors held constant.***
- H. The relationship of loss costs for individual coverages, (e.g., structures, appurtenant structures, contents, and loss of use/additional living expense) shall be consistent with the coverages provided.***

## **Audit**

1. Graphical representations of loss costs by ZIP Code and county will be reviewed.
2. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.
3. Individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, A-5 and A-6 will be used to assess coverage relationships.

## **Pre-Visit Letter**

36. Form A-4, page 119 – Be prepared to discuss changes in this form from last year.
37. Form A-5, page 120 – Be prepared to discuss changes in this form from last year. Aside from changes from last year, the ZIP Codes included will be discussed.

38. Form A-6, page 132 – Be prepared to discuss changes in this form from last year.

**Verified:** ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

**Professional Team Comments:**

Reviewed changes in Forms A-4, A-5, and A-6 from last year. Changes were related to the update of gradient to sustained conversion, revisions to Elena historical data, and the air density parameter in the model. Specifically reviewed each component of changes.

Revised Form A-4 with correction to Elena's loss costs to be provided to the Commission.

Revised Form A-4, page 119 received and reviewed by the Professional Team.

## **A-6 Deductibles and Policy Limits**

- A. The methods used in the development of mathematical distributions to reflect the effects of deductibles and policy limits shall be actuarially sound.***
  
- B. The relationship among the modeled deductible loss costs shall be reasonable.***

## **Audit**

The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for handling deductibles and policy limits. To the extent that historical data are used to develop mathematical depictions of deductibles and policy limit functions, demonstrate the goodness-of-fit of the data to fitted models. Justify changes from the prior submission in the relativities among corresponding deductible amounts for the same coverage.

## **Pre-Visit Letter**

32. A-6, page 100ff – Whether 2004 insurer claim experience is incorporated in the development, testing or verification of the current model version or not, describe the methods used to account for the implementation of multiple deductibles in the insurers' claim payment historical records for policy periods where more than one hurricane caused damage at a single location. Describe how multiple deductible claim experience in the historical record is included in the projection of future loss costs. Describe any differences between the process used to account for "multiple deductibles" in this submission and the process used in prior submissions.

33. A-6.2, page 102, (note under paragraph 2) – Describe the method contained within USWIND.

**Verified: YES**

**Professional Team Comments:**

Verified no changes were made in the methodology for handling deductibles and policy limits.

Reviewed handling of multiple deductibles in the model.

Discussed the need for revisions to the process in light of the new legislation HB9A.

## **A-7 Contents**

***A. The methods used in the development of contents loss costs shall be actuarially sound.***

***B. The relationship between the modeled structure and contents loss costs shall be reasonable, based on the relationship between historical structure and contents losses.***

### **Audit**

The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for contents coverage. To the extent that historical data are used to develop mathematical depictions of contents functions, demonstrate the goodness-of-fit of the data to fitted models. Justify changes from the prior submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

**Verified: YES**

**Professional Team Comments:**

Verified no changes were made in the methodology for handling contents losses.

Reviewed methods of developing contents loss costs from contents vulnerability curves.

## **A-8 Additional Living Expense (ALE)**

- A. The methods used in the development of Additional Living Expense (ALE) loss costs shall be actuarially sound.***
- B. ALE loss cost derivations shall consider the estimated time required to repair or replace the property.***
- C. The relationship between the modeled structure and ALE loss costs shall be reasonable, based on the relationship between historical structure and ALE losses.***

### **Audit**

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for ALE coverage. Documentation and justification of the following will be reviewed:
  - a. The method of derivation and data on which the ALE vulnerability function is based;
  - b. Validation data specifically applicable to ALE;
  - c. Assumptions regarding the coding of ALE losses by insurers;
  - d. The effects of demand surge on ALE for Hurricane Andrew;
  - e. Assumptions regarding the variability of ALE by size of property;
  - f. Statewide application of ALE assumptions;
  - g. Assumptions regarding ALE for mobile homes, tenants, and condo unit owners exposure;
  - h. The methods used to incorporate the estimated time required to repair or replace the property;
  - i. The methodology and available validation for determining the extent of infrastructure damage and its effect on ALE costs.
2. To the extent that historical data are used to develop mathematical depictions of ALE functions, demonstrate the goodness-of-fit of the data to fitted models.
3. Justify the differences in the relationship of structure and ALE loss costs from those previously found acceptable.

### **Pre-Visit Letter**

34. A-8.2, page 108 – Describe the validation test that resulted in the conclusion that “0.21% of the total value of ALE claims came from policies having no corresponding building or content claim”.

**Verified: YES**

**Professional Team Comments:**

Reviewed the validation testing of Hurricane Andrew claims data for ALE.

Verified no changes were made to the methodology for handling ALE.

Reviewed methods used to arrive at the resulting conclusion that “.21% of the total value of ALE claims came from policies having no corresponding building or content claim,” providing evidence that ALE damage to the infrastructure is included in the model.

**A-9 Output Ranges\***

*(\*Significant Revision)*

**A. Output Ranges shall be logical and any deviations supported.**

**B. All other factors held constant:**

- 1. Output ranges produced by the model shall have a pattern of declining loss costs with increasing deductibles.**
- 2. Output ranges produced by the model shall reflect lower loss costs for masonry construction versus frame construction.**
- 3. Output ranges produced by the model shall reflect lower loss costs for residential risk exposure versus mobile home risk exposure.**
- 4. Output ranges produced by the model shall reflect lower loss costs, in general, for inland counties versus coastal counties.**
- 5. Output ranges produced by the model shall reflect lower loss costs, in general, for northern counties versus southern counties.**
- 6. Output ranges produced by the model shall reflect lower loss costs for contents versus structures.**
- 7. Output ranges produced by the model shall reflect lower loss costs for additional living expense versus structures.**
- 8. Output ranges produced by the model shall be positive and non-zero for all given risk exposures.**

**Audit**

1. Forms A-7, A-8, and A-9 will be reviewed.

2. The modeler will be required to justify the following:
  - a. Changes from the prior submission of greater than five percent in weighted average loss costs for any county.
  - b. Changes from the prior submission of five percent or less in weighted average loss costs for any county.
3. Output Ranges will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.
4. Anomalies in the output range data will be reviewed and shall be justified.

### **Pre-Visit Letter**

We would like to review in detail the three major changes indicated in A-9, page 110.

35. A-9.2, page 110 – Describe the contribution to the differences in the output ranges from those in the prior submission, separately relative to:
  - a. updated storm set
  - b. gradient to sustained conversion
  - c. air density parameter update
  - d. hurricane frequency distribution revision
    - i. Provide impact of frequency distribution revision on each counties listed under paragraph 3.

**Verified: YES**

### **Professional Team Comments:**

Reviewed the impact on the statewide loss costs of the model updates to the storm set database, the gradient to sustained conversion and air density parameter, and the hurricane frequency distribution revision.

Reviewed percentage changes in the Output Ranges by county and the reason for these changes. Explanations found to be reasonable.

Verified the occurrences of 0.000 for the weighted average loss costs are due to the exposure weight file provided containing no exposure data for that policy form and construction within those counties.



## STATISTICAL STANDARDS – Mark Johnson, Leader

### S-1 Modeled Results and Goodness-of-Fit

- A. The use of historical data in developing the model shall be supported by rigorous methods published in currently accepted scientific literature.*
- B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods.*

### Audit

1. Forms S-1 and S-2 will be reviewed.
2. The modeler's characterization of uncertainty for wind speed, damage estimates, annual loss, and loss costs will be reviewed.

### Pre-Visit Letter

39. S-1, page 181 – What was the rationale for changing to the negative binomial distribution? This change was mentioned in the context of A-9, page 110, but is not discussed for this standard.
40. Form S-1, page 195 – Be prepared to discuss the changes in the probabilities from last year.
41. Form S-2, page 196 – Be prepared to discuss the changes in this form from last year. There is no top event.

**Verified: YES**

### Professional Team Comments:

Reviewed the change from Poisson to negative binomial frequency distribution, looked at several fits and the parameters. Reviewed graphical comparison of historical, Poisson, and negative binomial showing benefit of changing to negative binomial for a better fit to the historical data.

Evaluated results of Form S-1, Probability of Hurricanes per Year.

Reviewed differences in Form S-2 from last year and the absence of the top event in the current submission.

Reviewed various goodness-of-fit tests comparing modeled distributions with underlying historical data. Reviewed probability distributions, Chi-Square Tests, and Kolmogorov-Smirnov Tests for Rmax at several locations.

Clarified the data underlying the Rmax fits. Reviewed the lognormal fit of Rmax for NWS-38 data with updates.

## **S-2 Sensitivity Analysis for Model Output**

*The modeler shall have assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables using currently accepted scientific and statistical methods and have taken appropriate action.*

### **Audit**

1. The modeler's sensitivity analysis will be reviewed in detail. Statistical techniques used to perform sensitivity analysis shall be explicitly stated. The results of the sensitivity analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.
2. Form S-5 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

**Verified: YES**

### **Professional Team Comments:**

Reviewed results of EQE's sensitivity analyses performed on storm frequency rates, as mentioned in the submission.

## **S-3 Uncertainty Analysis for Model Output**

*The modeler shall have performed an uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods and have taken appropriate action. The analysis shall identify and quantify the extent that input variables impact the uncertainty in model output as the input variables are simultaneously varied.*

### **Audit**

1. The modeler's uncertainty analysis will be reviewed in detail. Statistical techniques used to perform uncertainty analysis shall be explicitly stated. The results of the uncertainty analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

2. Form S-5 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

**Verified: YES**

**Professional Team Comments:**

Reviewed the differences using a negative binomial rather than Poisson.

Reviewed the results of the uncertainty analysis performed on different model parameters.

Reviewed plot showing results of uncertainty analysis on storm frequency and loss estimation.

**S-4 County Level Aggregation\***

*(\* Significant Revision due to possible change in loss costs)*

***At the county level of aggregation, the contribution to the error in loss cost estimates attributable to the sampling process shall be negligible.***

**Audit**

Provide a graph assessing the accuracy associated with a low impact area such as Nassau County. We would expect that if the contribution error in an area such as Nassau County is small, the error in the other areas would be small as well. Assess where appropriate, the contribution of simulation uncertainty via confidence intervals.

**Pre-Visit Letter**

42. S-4, page 191 – Do you have an effective sample size?

**Verified: YES**

**Professional Team Comments:**

By virtue of EQE's use of Latin Hypercube sampling in the model, this Standard is not relevant.

## **S-5 Replication of Known Hurricane Losses**

***The model shall reasonably replicate incurred losses in an unbiased manner on a sufficient body of past hurricane events from more than one company, including the most current data available to the modeler. This Standard applies separately to personal residential and, to the extent data are available, to mobile homes. Personal residential experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail.***

### **Audit**

1. The following information for each insurer and hurricane will be reviewed:
  - a. The validity of the model assessed by comparing expected losses produced by the model to actual observed losses incurred by insurers at both the state and county level,
  - b. The version of the model used to calculate modeled losses for each hurricane provided,
  - c. A general description of the data and its source,
  - d. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
  - e. The date of the exposures used for modeling and the date of the hurricane,
  - f. An explanation of differences in the actual and modeled hurricane parameters,
  - g. A listing of the departures, if any, in the wind field applied to a particular hurricane for the purpose of validation and the wind field used in the model under consideration,
  - h. The type of property used in each hurricane to address:
    - a. Personal versus commercial
    - b. Residential structures
    - c. Mobile homes
    - d. Condominiums
    - e. Structures only
    - f. Contents only,
  - i. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.
  
2. The following documentation will be reviewed:
  - a. Publicly available documentation referenced in the submission,
  - b. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
  - c. An analysis that identifies and explains anomalies observed in the validation data,
  - d. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

3. The confidence intervals used to gauge the comparison between historical and modeled losses will be reviewed.
4. Form S-3 will be reviewed.
5. The results of one hurricane event for more than one insurance company and the results from one insurance company for more than one hurricane event will be reviewed to the extent data are available.

**Verified: YES**

**Professional Team Comments:**

Examined historical storms with special attention to the effects of model changes since last year.

### **S-6 Comparison of Projected Hurricane Loss Costs**

*The difference, due to uncertainty, between historical and modeled annual average statewide loss costs shall be reasonable, given the body of data, by established statistical expectations and norms.*

#### **Audit**

1. Form S-4 will be reviewed.
2. Justify the following:
  - a. Meteorological parameters,
  - b. The effect of by-passing storms,
  - c. The effect of actual hurricanes that had two landfalls impacting Florida,
  - d. The departures, if any, from the wind field, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration, and
  - e. Exposure assumptions.

**Verified: YES**

**Professional Team Comments:**

Examined aspects of Form S-4 at length. Investigated profile factor used in historical storms for consistency with profile factor used in the model.

## COMPUTER STANDARDS – Paul Fishwick, Leader

### **C-1 Documentation\***

*(\*Significant Revision)*

- A. The modeler shall maintain a primary document binder, containing a complete set of documents specifying the model structure, detailed software description, and functionality. Development of each section shall be indicative of accepted software engineering practices.**
- B. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the modeler's submission shall be consistently documented.**
- C. Documentation shall be created separately from the source code.**

### **Audit**

1. The primary document binder, in either electronic or physical form, and its maintenance process will be reviewed. The binder shall contain fully documented sections for each Computer Standard.
2. All documentation shall be easily accessible from a central location.
3. Complete user documentation, including all recent updates, will be reviewed.
4. Modeler personnel, or their designated proxies, responsible for each aspect of the software (i.e. user interface, quality assurance, engineering, actuarial) shall be present when the Computer Standards are being audited. Internal users of the software will be interviewed.
5. Provide verification that documentation is created separately from the source code.

**Verified: YES**

### **Professional Team Comments:**

Reviewed the primary document binder and the master list of reference documents, December 1997 – April 2005. The binder references electronic repositories.

## **C-2 Requirements\***

*(\*Significant Revision)*

***The modeler shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component.***

### **Audit**

Provide confirmation that a complete set of requirements for each software component, as well as for each database or data file accessed by a component, has been maintained and documented.

**Verified:** ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

### **Professional Team Comments:**

Reviewed documentation on requirements specifications for the software.

Revised response to C-2.1 moving quality assurance documentation statement to appropriate Standard (C-5) to be provided to the Commission.

Revised response to C-2.1, page 206 received and reviewed by the Professional Team.

## **C-3 Model Architecture and Component Design**

***The modeler shall maintain and document (1) detailed control and data flow diagrams and interface specifications for each software component, and (2) schema definitions for each database and data file. Documentation shall be to the level of components that make significant contributions to the model output.***

### **Audit**

1. The following will be reviewed:
  - a. Detailed control and data flow diagrams, completely and sufficiently labeled for each component,
  - b. Interface specifications for all components in the model,
  - c. Documentation for schemas for all data files, along with field type definitions,
  - d. Each network diagram including components, sub-component diagrams, arcs, and labels.
2. A model component custodian, or designated proxy, should be available for the review of each component.

## Pre-Visit Letter

43. C-3, page 207 – Be prepared to discuss how the model meets this standard.

Verified: YES

### Professional Team Comments:

Reviewed the method for creating and documenting flow diagrams. An example diagram was reviewed relative to the gradient to surface wind conversion modification.

### C-4 Implementation\*

(\*Significant Revision)

- A. The modeler shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.**
- B. The modeler shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.**
- C. All components shall be traceable, through explicit component identification in the flow diagrams, down to the code level.**
- D. The modeler shall maintain a table of all software components affecting loss costs, with the following table columns: (1) Component name, (2) Number of lines of code, minus blank and comment lines; and (3) Number of comment lines.**
- E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.**

### Audit

1. The interfaces and the coupling assumptions will be reviewed.
2. Provide the documented coding guidelines and confirm that these guidelines are uniformly implemented.
3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.
4. The traceability among components at all levels of representation will be reviewed.



5. The following information shall be available and will be reviewed for each component, either in a header comment block, source control database, or the documentation: component name, date created, dates modified and by whom, purpose or function of the component, and input and output parameter definitions.
6. The table of all software components as specified in C-4.D will be reviewed.
7. Model components and the method of mapping to elements in the computer program will be reviewed.
8. Comments within components will be examined for sufficiency and consistency.

### Pre-Visit Letter

44. C-4, page 208 – Be prepared to discuss how the model meets each part of this standard.

**Verified:** ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

### Professional Team Comments:

Reviewed the implementation of the new code for converting gradient to surface winds.

Reviewed software metrics report including the component name, number of lines of code, and number of comment lines. Reviewed CCCC Source Code Metrics.

Reviewed coding guidelines procedure.

Revised response to C-4E showing compliance with the comments requirement to be provided to the Commission.

Revised response to C-4.E, page 208 received and reviewed by the Professional Team.

## **C-5 Verification\***

*(\*Significant Revision)*

### **A. General**

***For each component, the modeler shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness.***

### **B. Component Testing**

- 1. The modeler shall use testing software to assist in documenting and analyzing all components.***
- 2. Unit tests shall be performed and documented for each component.***
- 3. Regression tests shall be performed and documented on incremental builds.***
- 4. Aggregation tests shall be performed and documented to ensure the correctness of all components, defining the model.***

### **C. Data Testing**

- 1. The modeler shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.***
- 2. The modeler shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.***

## **Audit**

- 1. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.***
- 2. The testing software used by the modeler will be reviewed.***
- 3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed.***

## Pre-Visit Letter

45. C-5, page 209 – Be prepared to discuss how the model meets each of this standard.
46. C-5, page 209 – Be prepared to show detailed unit test documentation for testing on each model component, including all aspects of the model (meteorology, actuarial, vulnerability, statistics, user interface, and other components).

**Verified: YES**

### Professional Team Comments:

Reviewed the software used to test the code developed in C++.

Reviewed CPPUNIT used for unit testing and several examples of the unit testing procedure.

Reviewed regression testing with follow-up procedures to characterize significant changes.

Reviewed in detail and reviewed examples of the process for creating new builds, test suites, setting of benchmarks, and the process for reconciling failed tests.

Reviewed tests of builds themselves. Reviewed integrated procedures at system level.

Reviewed the “child/parent” relationship in the context of the modeler’s implementation.

Reviewed the model’s testing procedures and software to verify that the software results are consistent with the intended simulation approach and the algorithms employed.

Reviewed modeler generated Test Suite software.

## **C-6 Model Maintenance and Revision**

- A. The modeler shall maintain a clearly written policy for model revision, including verification and validation of revised components, databases, and data files.***
- B. A revision to any portion of the model that results in a change in any Florida residential hurricane loss cost shall result in a new model version number.***
- C. The modeler shall use tracking software to identify all errors, as well as modifications to code, data, and documentation.***

### **Audit**

1. All policies and procedures used to maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, the modeler should provide the installation date under configuration control, the current version number, and the date of the most recent change(s).
2. The policy for model revision will be reviewed.
3. The tracking software will be reviewed.

### **Pre-Visit Letter**

47. C-6, page 211 – Be prepared to discuss how the model meets each part of this standard.

**Verified: YES**

### **Professional Team Comments:**

Reviewed EQE's policy for revisions to the model and EQE's ISO-compliant procedures regarding the maintenance of code, data, and documentation.

Reviewed software maintenance and revision flowchart, EQECAT Build/Machine Process.

## **C-7 Security\***

*(\*Significant Revision)*

*The modeler shall have implemented and fully documented security procedures for: (1) secure access to individual computers where the software components or data can be created or modified, (2) secure operation of the model by clients, if relevant, to ensure that the correct software operation cannot be compromised, (3) anti-virus software installation for all machines where all components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.*

### **Audit**

1. The written policy for all procedures and methods used to ensure the security of code, data, and documentation will be reviewed. Specify all security procedures.
2. Documented security procedures for access, client model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

**Verified: YES**

### **Professional Team Comments:**

Reviewed EQE's security policy for access to source code, data, and documentation.