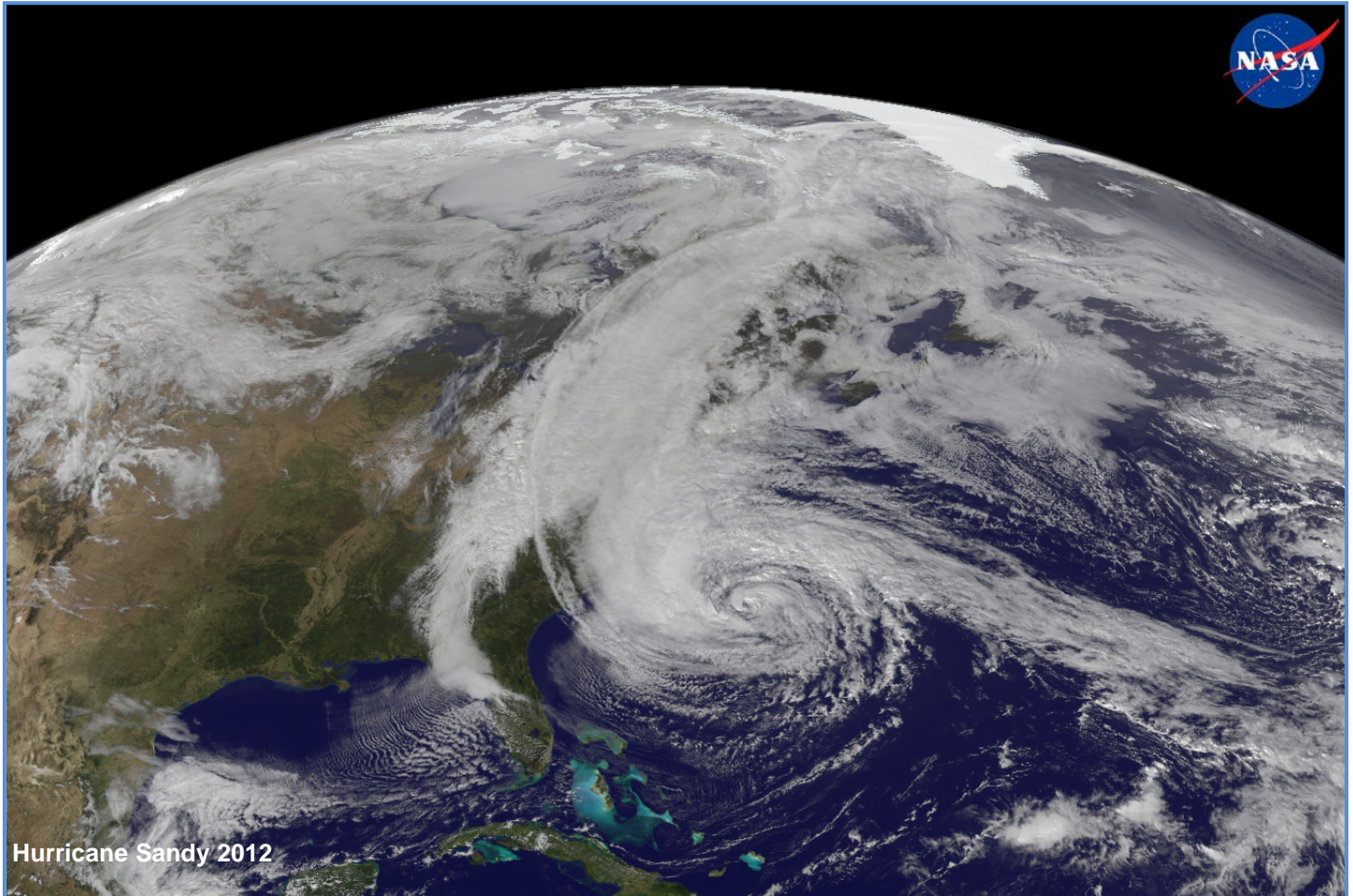


# Florida Commission on Hurricane Loss Projection Methodology



## Professional Team Report 2011 Standards

**EQECAT, Inc.**

**On-Site Review  
March 18-20, 2013**

**Additional Verification Review  
May 13, 2013**

On March 18-20, 2013, the Professional Team visited on-site at EQECAT, Inc. in Oakland, California. The following individuals participated in the review:

**EQECAT**

Branimir Betov, M.S., Director

Justin Brolley, Ph.D., Senior Research Scientist

Aarti Dinesh, Product Manager

Annes Haseemkundu, Ph.D., Atmospheric Scientist

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

Omar Khemici, Ph.D., P.E., Vice President, Model Development

John Mangano, Vice President, Meteorologist

Laura Maxwell, FCAS, MAAA, Consulting Actuary

David F. Smith, Senior Vice President, Technology Development and Consulting

Amanuel Teclé, Ph.D., Research Scientist

**Professional Team**

Jenni Evans, Ph.D., Meteorologist

Paul Fishwick, Ph.D., Computer Scientist

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

Marty Simons, ACAS, Actuary

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

Donna Sirmons, Staff

The review began with introductions and an overview of the audit process. EQECAT informed the Professional Team of two errors discovered since the initial submission:

- 1) An error in importing mitigation factors where mitigation measures were erroneously omitted during the migration of factors after the import process. At the time of the submission, the formal import process had not been finalized. The error was corrected by using a new released import. Form V-1 was impacted and the building strength sensitivity changed in Forms A-6 and A-7.
- 2) A coding error with regards to the building-code year bands for non-mobile home structures. The default year of construction used in completing Forms A-1, A-6, and A-7 was incorrect and affected two ZIP Codes in Pinellas County. The coding error was corrected by putting the year into the correct age band. Consequently, the model version number was revised to EQECAT Florida Hurricane Model 2013a.

The audit then followed with a discussion of the following significant model changes:

- Probabilistic hurricane database regenerated to be consistent with HURDAT as of May 14, 2012
- Simulation time period doubled from 150,000 years to 300,000 years
- Selective reduction in number of events from 47,315 to 32,032 in the stochastic storm set
- Increase in the windfield calculation time stepping resolution from 15 minutes to 5 minutes
- ZIP Code database updated to March 2012
- Update to mitigation measures
- Update in financial model to use discrete calculations instead of numerical integration for the computation of insured loss.

The Professional Team was unable to verify Standard V-3 (Mitigation Measures). Consequently, G-1 (Scope of the Computer Model and Its Implementation), G-4 (Independence of Model Components), A-6 (Loss Output), C-4 (Implementation), and C-5 (Verification) also could not be verified as they require the verification of the aforementioned standard. At the exit briefing, modeler options as given in the Report of Activities were presented to the modeler.

The Professional Team reviewed the following corrections to be included in the revised submission to be provided to the Commission no later than 10 days prior to the meeting to review the model for acceptability:

- Page 13, G-1.2 – revised to clarify model identification, to clarify probable maximum damage
- Page 15, G-1.2 – revised section 2 title
- Page 18, G-1.2 – revised to add years to reference citations
- Page 24, G-1.4 – revised to include correlation references for aggregation of losses, to update secondary modifier references, and to include literature in support of additional storms
- Page 27, G-1.5.B.2 – revised to clarify percentage changes in loss costs for each model component change
- Page 38, G-2.3 – revised to include new vulnerability and computer science independent peer reviews
- Page 59, M-4.10 – revised to update to 2011 requirements
- Page 66, V-1.E – revised to correct statement on separate vulnerability function for appurtenant structures
- Page 68, V-1.2 – revised claims data information
- Page 71, V-1.6 – revised to correct reinforced-masonry average cladding to mid/high-rise and to clarify vulnerability dependence on height provided
- Page 74, V-2.B – revised for clarity
- Page 74, V-2.1 – revised for clarity
- Page 91, A-2.A – definition of event revised
- Page 97, A-4.B, Figure 20 revised
- Page 105, A-6.J – revised to correct Disclosure number reference
- Form G-1
- Form G-2
- Form G-3
- Form G-4
- Form G-5
- Form G-6
- Form G-7
- Form M-1
- Form V-1
- Form V-2
- Form A-1
- Form A-2
- Form A-3
- Form A-7
- Form A-8
- Form S-1
- Form S-2

## **Additional Verification Review – May 13, 2013**

EQECAT submitted revisions to the original November, 2012 model submission under the 2011 Standards on April 18, 2013. The Professional Team completed an additional verification review on May 13, 2013 in Oakland.

The following individuals participate in the additional verification review.

### **EOECAT**

Branimir Betov, M.S., Director

Justin Brolley, Ph.D., Senior Research Scientist

Aarti Dinesh, Product Manager

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

Omar Khemici, Ph.D., P.E., Vice President, Model Development

Laura Maxwell, FCAS, MAAA, Consulting Actuary

Sriram Narasimhan, Ph.D., Structural Engineer via phone

David F. Smith, Senior Vice President, Technology Development and Consulting

Amanuel Tecele, Ph.D., Research Scientist

### **Professional Team**

Paul Fishwick, Ph.D., Computer Scientist

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

Marty Simons, ACAS, Actuary

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

Donna Sirmons, Staff

The additional verification review began with a discussion of the outstanding issues. EQECAT confirmed no additional changes were discovered or made since the April 16, 2013 revised submission.

EQECAT began with a presentation on the changes made since the March 2013 initial on-site review and an overview of the secondary structural modifiers (SSM) methodology. EQECAT provided revised results for Form V-2 and Form V-3 as the incorrect input file was used to complete the originally submitted Form V-2.

The Professional Team reviewed all materials in the re-submission that were impacted by the corrections noted previously.

All standards are now verified by the Professional Team.

## **Report on Deficiencies**

The Professional Team reviewed the following deficiencies cited by the Commission at the December 17, 2012 meeting. The deficiencies were corrected by the established time frame, and the corrections have been verified.

1. Standard G-1, Disclosure 2
  - a. Page 14, line 1: Response is unclear as the number 33,570 is suggested as 16 x 3100, which it is not, and two other values are provided – 32,032 on page 13 and 32,023 on page 14.
  - b. Page 16, line 7 from bottom: Response is unclear as the phrase “and vulnerability functions” after the semicolon appears as a sentence fragment.
2. Standard G-1, Disclosure 4 (pages 22-25)

Response is incomplete as various references provided in response to Standard A-4, Disclosure 2 (pages 99 and 100) are not listed in the List of References.
3. Standard G-1, Disclosure 5.C (pages 27-30)

Scale for maps is non-responsive to requirement II.A.5.e.3 in the *Report of Activities (page 46)*: “Maps will use three colors...dark blue and dark red designating the lowest and highest quantities, respectively. The color legend and associated map shall be comprised of an appropriate number of intervals to provide readability.” The minimum and maximum values and locations are not provided, while the bounds are  $\pm 30\%$ .
4. Standard M-4, Disclosure 9 (page 59)

Response is incomplete as maximum value and location were not provided in Figure 12 as required by II.A.5.e.3 in the *Report of Activities (page 46)*.
5. Standard V-1, Disclosure 1 (pages 67-68)

Response is unclear as the acronyms and abbreviations used in Figures 15 and 16 are not defined.
6. Standard V-1, Disclosure 11 (page 72)

Response is non-responsive as it does not specify assumptions as required.
7. Standard V-1, Disclosure 12 (page 72)

Response is non-responsive as it does not specify assumptions as required.
8. Standard V-1, Disclosure 13 (page 72)

Response is non-responsive as it does not address the demonstration of consistency of vulnerability function relationships by type of coverage with actual insurance data.
9. Standard V-1, Disclosure 14 (page 72)

Response is non-responsive as it does not address the demonstration of consistency of vulnerability function relationships by type of construction with actual insurance data.

10. Standard V-2.C (page 74)  
Response is non-responsive as it does not address the standard explicitly and directly.
11. Standard V-2, Disclosure 5 (page 78)  
Response is unclear as Figure 18 (page 78) and Figure 17 (page 76) are identical.
12. Standard V-3, Disclosures 2 & 3 (pages 79-80)  
Response is non-responsive due to mitigation measures updated in the model to accommodate more options for roof sheathing and foundation anchorage as well as several other options added for modeling mitigation measures.
13. Form M-2 (pages 148-150)  
Response is incomplete as minimum values and locations were not provided in Figures 28-30 as required by II.A.5.e.3 in the *Report of Activities* (page 46).
14. Form A-1 (pages 162-164)  
Response is incomplete as maximum and minimum values and locations were not provided in Figures 34-36 as required by II.A.5.e.3 in the *Report of Activities* (page 46).
15. Form A-5 (pages 213-220)  
Response is incomplete as maximum and minimum values and locations were not provided in Figures 44-51 as required by II.A.5.e.3 in the *Report of Activities* (page 46).

### **Report on Issues**

Time did not allow the Professional Team to discuss the following issues identified by the Commission at the December 17, 2012 meeting. The modeler will give a detailed presentation to the Commission on these issues during the trade secret session of the meeting to review the model for acceptability.

1. Development of loss costs in the model and changes in the loss costs from the last change in the model, specifically how the model treats coastal versus inland loss costs. Be prepared to fully explain the process for incorporating changes in the model including the analyses of the underlying data. More detail to be provided in the presentation and discussion of Form A-5.
2. Describe if the model makes assumptions for adjustor errors or contract ambiguity.



## **Professional Team Pre-Visit Letter**

The Professional Team's pre-visit letter questions are provided in the report under the corresponding standards.

### **Pre-Visit Letter**

The purpose of the pre-visit letter is to outline specific issues unique to the modeler's submission, and to identify lines of inquiry to be followed during the on-site review to allow adequate preparation by the modeler. Aside from due diligence with respect to the full submission, various questions that the Professional Team is certain to ask the modeler during the on-site review are provided in this letter. This letter does not preclude the Professional Team from asking for additional information during the on-site review that is not given below or discussed during an upcoming conference call that will be held, if requested by the modeler. One goal of the potential conference call is to address modeler questions related to this letter or other matters pertaining to the on-site review. The overall intent is to expedite the on-site review and to avoid last minute preparations that could just as easily have been handled earlier.

Some of this material may have been shown or may have been available on a previous visit by the Professional Team. The Professional Team will also be considering material in response to deficiencies and issues designated by the Florida Commission on Hurricane Loss Projection Methodology (Commission).

The goal of the Professional Team on-site review is to provide the Commission with a clear and thorough report of the model, subject to non-disclosure restrictions on proprietary information. All modifications, adjustments, assumptions, or other criteria that were included in producing the information requested by the Commission in the submission should be disclosed and will be reviewed.

It is important that all material prepared for presentation during the on-site review be presented using a medium that is readable by all members of the Professional Team simultaneously. The Professional Team will review selected computer code in conjunction with the reviews performed for each section. Computer code should be readily available in a format that will allow simultaneous visualization by the entire Professional Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Professional Team. The Professional Team should be provided access to internet connections through the Professional Team members' laptops for reference work that may be required while on-site.

The on-site schedule is tentatively planned to proceed in the following sequence: (1) presentation by the modeler of new or extensively updated material related to the model; (2) section by section review commencing within each section with pre-visit letter responses; (3) responses to new or significantly changed standards in the 2011 Report of Activities, and (4) responses to the audit items for each standard in the Report of Activities.

Be prepared to have available for the Professional Team's consideration, all insurance company claims data received since 2004, including all data related to the 2004 and 2005

hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2007 FHCF exposure data.

When the Professional Team arrives on-site, provide five (5) printed copies of all figures with scales for the X and Y axes labeled that are not so labeled in the submission. Label the figures with the same figure number as given in the submission. Also, provide five (5) printed copies of Form V-3 and the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete. Additionally, provide five (5) printed copies of Form A-6 (all 8 worksheets) and the electronic file(s) used to complete Form A-6 and Form A-7. The electronic files will be examined only on-site and will be deleted from the Professional Team member's laptop at the conclusion of the review.

Be prepared to provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2009. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

If any changes have been made in any part of the model or the modeling process from the descriptions provided in the original 2011 submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and all revised Forms where any output of the form changed.

As part of the on-site review, the Professional Team is charged with obtaining information regarding the two issues noted in the deficiency letter that will be later considered during the trade secret portion of the Commission meeting.

For your information, the Professional Team will arrive in business casual attire.

The pre-visit comments are grouped by standards sections.



**GENERAL STANDARDS – Mark Johnson, Leader****G-1 Scope of the Computer Model and Its Implementation\****(\*Significant Revision)*

- A. The computer model shall project loss costs and probable maximum loss levels for residential property insured damage from hurricane events.**
- B. The modeling organization shall maintain a documented process to assure continual agreement and correct correspondence of databases, data files, and computer source code to slides, technical papers, and/or modeling organization documents.**

**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 insured loss costs and probable maximum loss levels. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.
2. The process defined in Standard G-1.B will be: (1) reviewed for its inclusion of all stages of the modeling process, and (2) traced using the Computer Standards for one or more items listed in the response to Disclosure 5.
3. All software (1) located within the model, (2) used to compile data used by the model, (3) used to validate the model, (4) used to project model loss costs and probable maximum loss levels, and (5) used to create forms required by the *Report of Activities*:
  - a. Shall fall within the scope of the Computer Standards;
  - b. Shall be located in centralized, model-level file areas; and
  - c. Shall be reviewable interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each standard).
4. Maps, databases, or data files relevant to the modeling organization's submission will be reviewed.
5. Provide the following information related to changes in the model from the initial submission this year to each subsequent revision.
  - A. Model changes:
    1. A summary description of changes that affect, or believe to affect, the personal or commercial residential loss costs or probable maximum loss levels,
    2. A list of all other changes, and
    3. The rationale for each change.
  - B. Percentage difference in average annual zero deductible statewide loss costs for:
    1. All changes combined, and
    2. Each individual model component change.
  - C. For any modifications to Form A-4 since the initial submission, additional versions of Form A-5:

1. With the initial submission as the baseline for computing the percentage changes, and
  2. With any intermediate revisions as the baseline for computing the percentage changes.
- D. Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide loss costs for each model component change:
1. Between the previously accepted submission and the revised submission,
  2. Between the initial submission and the revised submission, and
  3. Between any intermediate revisions and the revised submission.

### Pre-Visit Letter

1. G-1.B, page 12: Illustrate and explain, in detail, the documented process used to comply with Standard G-1.B.
2. G-1, Disclosure 1, page 12: The model name should be referenced consistently throughout the submission document.
3. G-1, Disclosure 2, page 13: Define probable maximum damage and loss due to a single event.
4. G-1, Disclosure 2, page 14: Explain “wind speed probabilistic distributions.” Explain the relation to Wind Speed Joint Distribution given in Figure 1 (page 19).
5. G-1, Disclosure 2, page 15: The first paragraph addresses geocoding and not propagation of hazard to the site.
6. G-1, Disclosure 2, page 15: Explain how the building classification and/or vulnerability functions are based on insured value. Also explain how correlation is calculated and accounted for in loss aggregation.
7. G-1, Disclosure 2, page 15: Explain “discrete calculations” in the estimation of damage and loss.
8. G-1, Disclosure 2, page 18: The entire paragraph before Disclosure 3 seems to be out of place. The title of this section is Minimum Server Hardware Requirements. Explain.
9. G-1, Disclosure 5.A.1, page 25: Present in detail the supporting material for the changes to the model from the previously accepted submission.
  1. HURDAT updates will be reviewed under Standard M-1.
  2. Provide a detailed presentation of this item including the benefits from the doubling of the simulation time period, the optimization process of combining storms (including an example), and the demonstration that the reduced set of 32,032 events works. A demonstration of comparable results with 465,000 storms previously in the model (see page 256) which was based on Latin-Hypercube simulation with variance reduction is needed. Describe how nearly identical events are identified and defined.
  3. Provide a detailed presentation of this item.

4. This will be reviewed under Standard G-3. Provide maps with before and after centroids superimposed (as we have seen in the past).
5. Provide a detailed presentation of the changes.
6. Provide a detailed presentation of the changes.

**Verified:    NO    YES**

**Professional Team Comments:**

This standard cannot be verified pending verification of Standard V-3.

The Professional Team discussed their concern with referencing the model with various names throughout the submission. The model submitted for review and a determination of acceptability under the 2011 Standards is EQECAT Florida Hurricane Model 2013a. The submission document will be revised to provide clarification. The modeler agreed that all references to USWIND in the submission will be replaced to specify the model being reviewed in the future.

Reviewed in detail the changes to the meteorological, vulnerability, and financial model components.

Reviewed the table of model changes and subsequent revisions of the table during the audit, and verified that the items of the table corresponded with the major changes to the model captured in response to Standard G-1, Disclosure 5.

Discussed the correlation between building classification/vulnerability functions and insured value/replacement cost.

Discussed the probabilistic distribution discrete calculations in the estimation of damage and loss.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

**\*\*\*Additional Verification Review Comments\*\*\***

Verified after resolution of outstanding issues with Standard V-3.

## **G-2 Qualifications of Modeling Organization Personnel and Consultants**

- A. Model construction, testing, and evaluation shall be performed by modeling organization personnel or consultants who possess the necessary skills, formal education, and experience to develop the relevant components for hurricane loss projection methodologies.**
- B. The model or any modifications to an accepted model shall be reviewed by either modeling organization personnel or consultants 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 certify Forms G-1 through G-6 as applicable and shall abide by the standards of their profession.**

### **Audit**

1. The professional vitae of modeling organization personnel and consultants 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 under consideration will be reviewed. Signatories on the individual forms will be required to provide a description of their review process.
3. Discuss any incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

### **Pre-Visit Letter**

- 10.G-2, Disclosure 2.A, page 33: Information on meteorology consultants involved in the Acceptability Process shall be included.
- 11.G-2, Disclosure 2.B, page 36: Resumes for the new employees listed should be available.
- 12.G-2, Disclosure 3.A, page 38: Describe how the reviews from 1995, 1996, and especially the computer science review of 1998 are relevant to the EQECAT Florida Hurricane Model 2013.
- 13.G-2, Disclosure 3.A, page 38: Clarify the roles of Dr. Kishor Mehta and Dr. James McDonald with respect to contributions to the model and independent peer reviews.

14.G-2, Disclosure 3.B, page 40: The meteorology review of Professor Tuleya should be available.

**Verified: YES**

**Professional Team Comments:**

Reviewed updated vulnerability review performed by Professor S. Narasimhan of the vulnerability model in 2013, Review of EQECAT Vulnerability Curves.

Reviewed updated software review performed by Dr. Gamil Serag Eldin and Dr. Kashif Ali of the computer science aspects of the model in 2013, Software Review Report 3.14.2013.

Reviewed resumes of new personnel:

- John Binu, M.Sc. Computer Application, Bharathiar University, India; B.Sc. Computer Science, Kerala University, India
- Gopi Goteti, Ph.D. Earth System Science (Hydrology), University of California, Irvine, CA; M.S. Earth System Science, University of California, Irvine, CA; M.S.C.E. Civil Engineering (Water Resources), University of Washington, Seattle, WA; B.Tech. Civil Engineering, Indian Institute of Technology, Mumbai, India
- Rodney Griffin, B.Sc. Information Systems and Computer Science, University of South Africa; Diploma of DataMetrics, Operations Research and Statistics, University of South Africa
- Laura Maxwell, B.S. Mathematics, Moravian College, Bethlehem, PA (consultant)
- Ilyes Meftah, M.S. Applied Mathematics and Quantitative Finance; Dauphine University, Paris, France; M.S. Financial and Economics Engineering, Nice Sophia Antipolis University, Nice, France; M.Sc. Mathematics and Applications; Pierre et Marie Curie University, Paris, France
- Jonathan Moss, B.A. Mathematics, St. Norbert College, DePere, Wisconsin
- James Scott, M.S. Computer Science, San Francisco State University, San Francisco, CA; M.S. Chemistry, University of California, Berkeley, CA; B.S. Chemistry, Rice University, Houston, TX
- Marian Szeffler, M.S. Electrical Engineering, Gdansk University of Technology, Poland
- Amanuel Teclé, Ph.D. Structural and Wind Engineering, Florida International University, Miami, Florida; M.Sc. Environmental Engineering and Sustainable Infrastructure; Royal Institute of Technology, Stockholm, Sweden; B.Sc. Civil Engineering, University of Asmara, Asmara, Eritrea
- Padmini Vijay, B.S. Electrical Engineering, University of Mumbai, India

Discussed that there were no departures of personnel attributable to violations of professional standards.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

**G-3 Risk Location**

- A. ZIP Codes used in the model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the model. ZIP Code information shall originate from the United States Postal Service.***
- B. ZIP Code centroids, when used in the model, shall be based on population data.***
- C. ZIP Code information purchased by the modeling organization shall be verified by the modeling organization for accuracy and appropriateness.***

**Audit**

1. Provide geographic displays for all ZIP Codes.
2. Provide geographic comparisons of previous to current locations of ZIP Code centroids.
3. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.
4. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.

**Verified: YES**

**Professional Team Comments:**

Discussed the methodology for updating and validating ZIP Code centroids.

Reviewed impact of changes due to update of ZIP Code centroids resulting in a decrease in loss costs.

Reviewed geographic displays of ZIP Codes and comparisons of new centroid locations to previous locations for the entire state.

Reviewed specific ZIP Code centroids in Monroe County.

Reviewed the data underlying the centroid shift for ZIP Code 00041 in Broward County.

Reviewed set of slides prepared by EQECAT to address Audit items.



## **G-4 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.*

### **Audit**

1. Demonstrate that the model components adequately portray hurricane phenomena and effects (damage, loss costs, and probable maximum loss levels). 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.

**Verified:    NO    YES**

### **Professional Team Comments:**

This standard cannot be verified pending verification of Standard V-3.

Reviewed set of slides prepared by EQECAT to address Audit items.

### **\*\*\*Additional Verification Review Comments\*\*\***

There was no evidence to suggest that one component of the model was artificially adjusted to compensate for another component.

Verified after resolution of outstanding issues with Standard V-3.

## G-5 Editorial Compliance

***The submission and any revisions provided to the Commission throughout the review process shall be reviewed and edited by a person or persons with experience in reviewing technical documents who shall certify on Form G-7 that the submission has been personally reviewed and is editorially correct.***

### Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of December 31, 2011*.
2. Describe all changes to the submission document since the previously accepted submission that might impact the final document submission.
3. Demonstrate that the submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and inclusion of extraneous data or materials.
4. Demonstrate that the submission has been reviewed by the signatories on Forms G-1 through G-6 for accuracy and completeness.
5. The modification history for submission documentation will be reviewed.
6. A flowchart defining the process for form creation will be reviewed.
7. Form G-7 will be reviewed.

**Verified: YES**

### Professional Team Comments:

Editorial items noted by the Professional Team were satisfactorily addressed during the audit. The Professional Team has reviewed the submission per Audit item 3, but cannot guarantee that all editorial difficulties have been identified. The modeler is responsible for eliminating such errors.

Discussed with Justin Brolley his process for editorial review.

Reviewed set of slides prepared by EQECAT to address Audit items.

## Meteorological Standards – Jenni Evans, Leader

### M-1 Base Hurricane Storm Set\*

(\*Significant Revision)

- A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of August 15, 2011 (or later). Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.**
- B. Any trends, weighting, or partitioning shall be justified and consistent with currently accepted scientific literature and statistical techniques. Calibration and validation shall encompass the complete Base Hurricane Storm Set as well as any partitions.**

### Audit

1. The modeling organization's Base Hurricane Storm Set will be reviewed.
2. Provide a flowchart illustrating how changes in the HURDAT database are used in the calculation of landfall distribution.
3. Reasoning and justification underlying any modification by the modeling organization to the Base Hurricane Storm Set will be reviewed.
4. Reasoning and justification underlying any short-term and long-term variations in annual hurricane frequencies incorporated in the model will be reviewed.
5. Modeled probabilities will be 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.
6. Form M-1 will be reviewed for consistency with Form S-1. Changes to the modeling organization's Base Hurricane Storm Set from the previously accepted submission will be reviewed.
7. Comparisons of modeled probabilities and characteristics from the complete historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against the complete historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

**Pre-Visit Letter**

15. M-1, Disclosure 1, page 46: Discuss the process used to update the Base Hurricane Storm Set from the version of HURDAT used. Provide the list of all storms added or modified.
24. Form M-1, page 144: Justify the distribution of modeled storms, in particular for Region C.
25. Form M-1, page 137: Verify consistency between Form M-1 and Form S-1 (page 208).

**Verified: YES**

**Professional Team Comments:**

Reviewed storm set event optimization examples and sensitivity tests.

Reviewed table of storms added and modified in the modeler's Base Hurricane Storm Set.

Reviewed in detail the changes in intensity and landfall locations for storms in the model's historical database:

- NoName 1921-06
- NoName 1925-04
- NoName 1926-01
- NoName 1926-07
- NoName 1926-10
- NoName 1928-01
- NoName 1928-04
- NoName 1929-02
- NoName 1933-05
- NoName 1935-02
- NoName 1935-06

Discussed that historical storms (Base Hurricane Storm Set) used in one form should be consistent across all forms and their use should be supported by literature. Modeler will provide revised Forms M-1 and S-1 with historical storm frequencies updated to include the additional storms given in Form A-2 and with the 112 year period (1900-2011).

Reviewed the procedure for incorporating and validating updates to the Base Hurricane Storm Set.

Discussed that no short- or long-term variations are imposed.

Reviewed inconsistency between Forms M-1 and S-1. Form S-1 revised to represent the 112 year period 1900-2011.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Reviewed justification for additional storms in Form A-2 with reference to storm characteristics, modeled windfield and damage thresholds. The National Hurricane Center storm reports or peer reviewed literature will be added to the master list of references provided in Standard G-1, Disclosure 4.

Reviewed storm set event optimization sensitivity analyses. Reviewed correlation between loss costs and hurricane parameters of windspeed, azimuth, forward speed, and Rmax at landfall by Saffir-Simpson category for a landfall in Miami.

Reviewed plots of loss costs percentage changes by ZIP Code in Monroe County due to the HURDAT updates for frame owners and masonry owners.

## M-2 Hurricane Parameters and Characteristics

***Methods for depicting all modeled hurricane parameters and characteristics, including but not limited to windspeed, radial distributions of wind and pressure, minimum central pressure, radius of maximum winds, landfall frequency, tracks, spatial and time variant windfields, and conversion factors, shall be based on information documented in currently accepted scientific literature.***

### Audit

1. All hurricane parameters used in the model will be reviewed.
2. Prepare graphical depictions of hurricane parameters as used in the model. Describe and justify:
  - a. The data set basis for the fitted distributions,
  - b. The modeled dependencies among correlated parameters in the windfield component and how they are represented,
  - c. The asymmetric nature of hurricanes,
  - d. The fitting methods used and any smoothing techniques employed.
3. The treatment of the inherent uncertainty in the conversion factor used to convert the modeled vortex winds to surface winds will be reviewed and compared with currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location within the windfield for a given hurricane intensity will be reviewed.
4. All cited scientific literature provided in Standard G-1 will be reviewed to determine applicability.
5. All external data sources that affect model generated windfields will be identified and their appropriateness will be reviewed.
6. Describe the value(s) of the far-field pressure used in the model and approximate its sensitivity on the average annual zero deductible statewide loss costs.

### Pre-Visit Letter

- 16.M-2, Disclosure 7, page 52: Describe the process used to update the probability distributions based on reanalysis changes to the earlier years in the HURDAT database. As of May 2012, HURDAT had been reanalyzed through 1900-1935, with substantial changes being most recently included for 1931-1935.
- 17.M-2, Disclosure 9, page 52: Provide hurricane landfall frequency distribution at a resolution higher than Form M-1 and consistent with the smoothing of the 10 nautical mile segments.



**Verified: YES**

**Professional Team Comments:**

Reviewed comparison of Rmax cumulative distribution functions (CDFs) for historical and stochastic events statewide.

Reviewed plot of annual frequency in the stochastic set by milepost segments for each Saffir-Simpson category.

Reviewed table of hurricane parameters used in the model.

Reviewed the distribution of modeled storms in Region C. Verified no new Region C landfalling storms.

Reviewed list of references used in developing the hurricane database. Reviewed additional NHC references for other storms provided in Form A-2.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

### M-3 Hurricane Probabilities

- A. Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.**
- B. Modeled hurricane landfall frequency distributions shall reflect the Base Hurricane Storm Set used 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).**
- C. Models shall use maximum one-minute sustained 10-meter windspeed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm Set used to develop landfall frequency distributions 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 windspeed shall be within the range of windspeeds (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

1. Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.
2. Describe and support the method of selecting stochastic storm tracks.
3. 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.
4. Provide any modeling organization specific research performed to develop the functions used for simulating model variables or to develop databases.
5. Form S-3 will be reviewed for the probability distributions and data sources.

**Pre-Visit Letter**

18.M-3, Disclosure 1, page 54: Provide a complete list of references used in developing the assumptions used.

19.M-3, Disclosure 1, page 54: Justify the use of the period 1900-2011 for frequency distribution when the dataset for storm direction ends in 2001 (page 52).

20.M-3, Disclosure 2, page 55: Provide a rationale for the probability distributions used. Include a complete list of underlying databases from the public domain.

**Verified: YES**

**Professional Team Comments:**

Reviewed graphical comparison of cumulative distribution functions of forward speed and landfall angle based on HURDAT 2001 and HURDAT 2011 and comparison to the model hurricane storm set. Reviewed significance checks for agreement performed by the modeler.

Discussed the rationale for the probability distributions to model storm parameters. Reviewed the complete list of underlying databases as presented in the submission.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

## **M-4 Hurricane Windfield Structure**

- A. Windfields generated by the model shall be consistent with observed historical storms affecting Florida.***
- B. The translation of land use and land cover or other source information into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.***
- C. With respect to multi-story structures, the model windfield shall account for the effects of the vertical variation of winds if not accounted for in the vulnerability functions.***

### **Audit**

1. Provide any modeling organization-specific research performed to develop the windfield functions used in the model. Identify the databases used.
2. Provide any modeling organization-specific research performed to derive the roughness distributions for Florida and adjacent states.
3. The spatial distribution of surface roughness used in the model will be reviewed.
4. Identify other variables in the model that affect over-land surface windspeed estimation.
5. Provide detailed comparisons of the model windfield with Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).
6. For windfield and/or pressure distributions not previously reviewed, present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable windfield characteristics.
7. The effects of vertical variation of winds as used in the model where applicable will be reviewed.
8. Form M-2 will be reviewed.

### **Pre-Visit Letter**

- 21.M-4, Disclosure 3, page 57: Provide a detailed description of the formulation and implementation of the increase in temporal resolution and to justify the consequent increase in loss costs.
- 22.M-4, Disclosure 10, page 59: Provide all information required for Hurricane Charley (2004), Hurricane Jeanne (2005), and Hurricane Wilma (2005). The disclosure description as given in the submission was not updated.

26. Form M-2, page 147: Discuss the relative values of the wind maxima over actual and open terrain.

**Verified: YES**

**Professional Team Comments:**

Reviewed the new time-step implementation and discussed the impact on the modeled loss costs. Reviewed hypothetical illustration explaining how maximum winds increase due to increases in temporal resolution.

Reviewed peak gust footprint maps compared to observations for Hurricanes Charley (2004), Jeanne (2004), and Wilma (2005). Reviewed statistics diagnostics in support of model results.

Reviewed table of windspeeds, direction, and roughness lengths. Discussed spatial distributions of winds in Form M-2.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Reviewed plots of Hurricane Charley (2004), Hurricane Jeanne (2005), Hurricane Katrina (2005), and Hurricane Wilma (2005) with maximum windspeeds plotted at each location in 5-minute time steps (new) and 15-minute time steps (old), as well as difference maps.

Discussed storm characteristics most likely to result in modeled wind changes with the new 5-minute time step.

**M-5 Landfall and Over-Land Weakening Methodologies**

- A. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records and with current state-of-the-science.***
- B. The transition of winds from over-water to over-land within the model shall be consistent with current state-of-the-science.***

**Audit**

1. Describe the variation in over-land decay rates used in the model.
2. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.
3. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed. Provide color-coded snapshot maps of roughness length and spatial distribution of windspeeds over-land and over-water for Hurricane Jeanne (2004), Hurricane Dennis (2005), and Hurricane Andrew (1992) at the closest time after landfall.

**Pre-Visit Letter**

23.M-5, Disclosure 2, page 62: Provide additional over-land decay examples.

**Verified: YES**

**Professional Team Comments:**

Verified no changes in the model treatment of over-land decay from the previous submission.

Reviewed graphical comparison of modeled versus observed over-land decay for Hurricane Andrew (1992), Hurricane Charley (2004), Hurricane Jeanne (2005), and Hurricane Katrina (2005) in Louisiana.

Reviewed plot of Hurricane Charley (2004) landfall inland decay at 5-minute increments.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.



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

- A. The magnitude of asymmetry shall increase as the translation speed increases, all other factors held constant.***
- B. The mean windspeed shall decrease with increasing surface roughness (friction), all other factors held constant.***

**Audit**

1. Form M-3 and the modeling organization's sensitivity analyses provide the information used in auditing this standard.
2. Justify the relationship between central pressure and radius of maximum winds.
3. Justify the variation of the asymmetry with the translation speed.

**Verified: YES**

**Professional Team Comments:**

Verified no change in the treatment of hurricane asymmetry from the previous submission.

Reviewed set of slides prepared by EQECAT to address Audit items.

## VULNERABILITY STANDARDS – Masoud Zadeh, Leader

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

(\*Significant Revision)

- A. Development of the vulnerability functions shall be based on any or a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. However, any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, and historical data.**
- B. The method of derivation of the vulnerability functions and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.**
- C. Residential building stock classification shall be representative of Florida construction for personal and commercial residential properties.**
- D. Building height/number of stories, primary construction material, year of construction, location, and other construction characteristics, as applicable, shall be used in the derivation and application of vulnerability functions.**
- E. Vulnerability functions shall be separately derived for commercial residential building structures, personal residential structures, mobile homes, appurtenant structures, contents, and time element coverages.**
- F. The minimum windspeed that generates damage shall be consistent with fundamental engineering principles.**
- G. Vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Vulnerability functions shall not include explicit damage to the structure due to flood, storm surge, or wave action.**

### Audit

1. Historical data shall be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. For historical data used to develop vulnerability functions, demonstrate the goodness-of-fit of the data. 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 shall be available for review.

2. Copies of any papers, reports, and studies used in the development of the vulnerability functions shall 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 time element coverages shall be available. The magnitude of logical changes among these items for a given windspeed shall be explained and validation materials shall be available.
4. Justify the construction types and characteristics used.
5. Provide validation of the mean vulnerability functions and associated uncertainties.
6. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement. If age of building is used as a surrogate for building code and code enforcement, provide complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s).
7. Provide validation material for the disclosed minimum windspeed. Provide the computer code showing the inclusion of the minimum windspeed at which damage occurs.
8. The effects on building vulnerability from local and regional construction characteristics and building codes will be reviewed.
9. Describe whether and/or how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify vulnerability functions. Examples include the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.
10. Provide the percentage of damage at or above which the model assumes a total loss.
11. Form V-1 will be reviewed.

### **Pre-Visit Letter**

- 27.V-1.B, page 66: Explain how the uncertainties in vulnerability functions are developed, including the form and basis of the probability distributions around the mean damage ratio for a given windspeed level. Provide examples.
- 28.V-1, Disclosure 1, pages 67-68: Explain Figure 15 and Figure 16, specifically as to how under-insurance, ground up loss, and corrections for unreported data are addressed. Provide examples for applications to the development of vulnerability functions for content and time element coverages.
- 29.V-1, Disclosure 2, page 68: Describe the breakdown of loss data among building, content, and time element. Provide any new insurance data received and analyzed since 2007.

- 30.V-1, Disclosure 3, page 68: Provide support for Disclosure 3. Describe the extent to which the vulnerability functions have changed since 1994.
- 31.V-1, Disclosures 8-14, pages 71-72: Disclosures 8 through 14 are new disclosures for V-1. Prepare to discuss in depth.
- 32.V-1, Disclosures 8 & 9, page 71: Discuss the basis for combining appurtenant structures with corresponding building claims and not developing them separately.
- 33.V-1, Disclosures 13 & 14, page 72: Provide examples of goodness of fit tests for vulnerability functions.
- 40.Form V-1, page 157: Describe the process and provide the documentation for all steps to complete Form V-1. Discuss the reasons why Part A values are the same or have reduced relative to the previous submission. Explain why this reduction is shown for wood frame, mobile home, and concrete, yet is not shown for masonry construction in Part B.

**Verified: YES**

**Professional Team Comments:**

Discussed in detail the error in importing mitigation factors for completing Form V-1. At the time of submission preparation, the direct import process had not been finalized so an intermediate process was used, and this resulted in errors.

Reviewed the reference structure file containing definitions and descriptions for Form V-1 input. Reviewed the new direct import process to ensure correct import of data.

Reviewed the flowchart and process for completion of Form V-1.

Reviewed a revised Form V-1. Reviewed revised input file with changes in the secondary modifiers used to complete Form V-1.

Reviewed examples of vulnerability function uncertainties for building, contents, and time element damage.

Reviewed process for developing building and contents vulnerability functions.

Reviewed schematic of probability distribution functions showing damage and loss data.

Reviewed the beta fitted probability distribution function on binned damage claims data for wood frame.

Reviewed table of insured values and losses for building, content, and time element. Discussed claims data received and analyzed for Hurricane Ike (2008) and Hurricane Gustav (2008), but no new loss data has been received and analyzed for Florida since 2007.

Reviewed the series of updates to the vulnerability functions since 1994. Discussed specifically the breakdown of Florida vulnerability functions by region. Discussed the mobile home vulnerability function revisions following the 2004 and 2005 storms.

Discussed the application of the building vulnerability functions to both building and appurtenant structures.

Reviewed the default structure types for personal residential and the factors applied for unknown structure types.

Discussed that vulnerability functions are developed through statistical regression of claims data.

Discussed regression analyzes by coverage to ensure consistency with actual insurance data.

Reviewed scatter plots of claims data with masonry, wood frame, and contents vulnerability functions.

Discussed the justification for not having separate vulnerability functions for appurtenant structures.

Reviewed goodness-of-fit plots for building and contents vulnerability functions for frame and masonry structure types.

Verified model losses in Florida come from storms that produce 40 mph gust winds anywhere in Florida including landfalling storms in Florida and neighboring states and by-passing storms.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Discussed HWIND sources of windspeeds used in development of the vulnerability functions. The HWIND data will be added to the master list of references provided in Standard G-1, Disclosure 4.

**V-2 Derivation of Contents and Time Element Vulnerability Functions\****(\*Significant Revision)*

- A. The relationship between the modeled structure and contents vulnerability functions and historical structure and contents losses shall be reasonable.**
- B. Time element vulnerability function derivations shall consider the estimated time required to repair or replace the property.**
- C. The relationship between the modeled structure and time element vulnerability functions and historical structure and time element losses shall be reasonable.**
- D. Time element vulnerability functions used by the model shall include time element coverage claims associated with wind, flood, and storm surge damage to the infrastructure caused by a hurricane.**

**Audit**

1. 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.
2. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for contents.
3. Documentation and justification of the following will be reviewed:
  - a. The method of derivation and data on which the time element vulnerability functions are based;
  - b. Validation data specifically applicable to time element coverages;
  - c. Assumptions regarding the coding of time element losses by insurers;
  - d. The effects of demand surge on time element for the 2004 and 2005 hurricane seasons;
  - e. Assumptions regarding the variability of time element losses by size of property;
  - f. Statewide application of time element coverage assumptions;
  - g. Assumptions regarding time element coverage 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 time element costs.
4. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for time element.
5. To the extent that historical data are used to develop mathematical depictions of time element functions, demonstrate the goodness-of-fit of the data to fitted models.



**Pre-Visit Letter**

- 34.V-2, pages 74-78: Discuss in depth and provide supporting documentation.
- 35.V-2.B, page 74: Provide the basis and documentation on repair and replacement time.
- 36.V-2.D, page 74: Describe how time element vulnerability functions include claims associated with wind, flood, and storm surge damage to the infrastructure.
- 37.V-2, Disclosure 1, pages 74-75: Discuss in more detail your response to this disclosure.
- 38.V-2, Disclosures 3 & 4, page 77: Discuss how the 40 mph windspeed threshold corresponds to the responses given and to V-2.C (page 74).

**Verified: YES**

**Professional Team Comments:**

Discussed in depth the major factors used in determining time element loss costs and the damage ratio calculations for building, contents, and time element losses.

Discussed that repair and replacement time are implicitly included in claims data.

Discussed the effect of damage to utilities and infrastructure on time element losses.

Discussed damage ratio calculations for building and content damage to determine time element damage ratios.

Reviewed personal residential building and contents vulnerability functions for average cladding reflecting damage starting at 40 mph peak gust windspeeds.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

### **V-3 Mitigation Measures**

**A. Modeling of mitigation measures to improve a structure's wind resistance and the corresponding effects on vulnerability shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include fixtures or construction techniques that enhance the performance of the structure and its contents and shall consider:**

- **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 that enhance the performance of the structure and its contents shall be justified as to the impact on reducing damage whether done individually or in combination.**

#### **Audit**

1. Form V-2 and Form V-3 (Trade Secret item) provide the information used in auditing this standard.
2. Individual mitigation measures as well as their effect on damage due to use of multiple mitigation measures will be reviewed. Any variation in the change over the range of windspeeds for individual and multiple mitigation measures will be reviewed.
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**

- 39.V-3, page 79: Provide a detailed description of changes to mitigation measures modeling. Discuss the changes and the basis for the changes in modifiers.
41. Form V-2, page 160: Provide the process and steps taken to complete this form along with documentation. Compare this form with the previous submission Form V-2. Explain the differences.

**Verified:    NO    YES**

#### **Professional Team Comments:**

Forms V-2 and V-3 were under revision from the initial submission and were unable to be verified while on-site. Further review of the mitigation measures as implemented in the model is necessary.

Reviewed new mitigation features added for roof sheathing and foundation anchorage. Reviewed updates to the performance scoring of some existing mitigation measures.

Reviewed matrix of quality factors based on secondary structural modifiers for wood frame structures. Reviewed methodology and table of secondary modifiers scoring. Reviewed a revised table of secondary structural modifiers with the previous scoring and revised scoring factors. Reviewed specific examples.

Reviewed the process for completing Form V-2.

Discussed change in process for modeling the reference structure in Form V-2.

Reviewed Form V-3 and confirmed consistency with the initially submitted Form V-2. Revised Forms V-2 and V-3 will need to be reviewed.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Documentation reviewed:

- North Atlantic Hurricane Model – Principles and Methodology, January 31, 2013
- Secondary Structural Modifiers: Features and Model Description, revised March 2013
- Table of Secondary Structural Modifications listing components, previous scoring factors, revised scoring factors, and comments

### **\*\*\*Additional Verification Review Comments\*\*\***

Verified no changes were made in the model; only changes to the input file for Forms V-2 and V-3 as the incorrect input file was used to complete the original Forms V-2 and V-3. Reviewed the Form V-2 input file.

Reviewed changes to skylight cover from strengthened type to ordinary for both frame and masonry and to anchor bolt diameter from 1/2" to 5/8" for frame structures only.

Reviewed the five secondary structural modifier systems, features, and options.

Reviewed building code and building code enforcement input options chosen by the model user.

Reviewed total score computation for each of the five secondary structural modifier systems.

Reviewed quality modifier calculation and plot of quality modifier versus total score.

Reviewed in detail revised results in Forms V-2 and V-3. Discussed explanations for differences from previous submission.

Discussed relationship of the skylight opening protection with the roof system.

Reviewed “double dip” corrections in total score for secondary modifiers. Reviewed spreadsheet of secondary modifier factors indicating only two possible double dip combinations.

Reviewed in detail the effect of a weak or strong roof-to-wall connection with the overall performance of the roof system.

Reviewed table of default secondary structures for residential masonry structures classified by age group. Discussed sources of engineering research as basis for the default values.

Reviewed documentation for secondary structural modifiers methodology.

Reviewed the interaction model for the five secondary structural modifier systems.

Reviewed plots of roof system strength reduction factor versus total score and versus influence factor.

Discussed via phone with Dr. Sriram Narasimhan his work with Dr. Bob Bailey in developing the secondary structural modifiers methodology.

Reviewed the changes in metal roof cover from the previous submission.

Reviewed and discussed “Secondary Structural Modifiers: Features and Model Description,” Revision 2, 2013. Several inconsistencies and/or lack of documentation on secondary modifiers impacting calculations were noted in the documentation and brought to the modeler’s attention.

The Professional Team recommended the secondary structural modifiers methodology be presented to the Commission in depth during the Trade Secret session.

**ACTUARIAL STANDARDS – Marty Simons, Leader****A-1 Modeling Input Data**

- A. When used in the modeling process or for verification purposes, adjustments, edits, inclusions, or deletions to insurance company input data used by the modeling organization shall be based upon accepted actuarial, underwriting, and statistical procedures.***
- B. All modifications, adjustments, assumptions, inputs and/or input file identification, and defaults necessary to use the model shall be actuarially sound and shall be included with the model output report. Treatment of missing values for user inputs required to run the model shall be actuarially sound and described with the model output report.***

**Audit**

1. Quality assurance procedures shall include methods to assure accuracy of insurance data. Compliance with this standard will be readily demonstrated through documented rules and procedures.
2. All model inputs and assumptions will be reviewed to determine that the model output report appropriately discloses all modifications, adjustments, assumptions, and defaults used to produce the loss costs.

**Verified: YES**

**Professional Team Comments:**

Discussed with Laura Maxwell, consulting actuary, her review of all the data and responses provided for the Actuarial Standards. Discussed her line of inquiries with the modeler and her confidence in the results and responses.

Discussed review of claims data for consistency with modeled losses.

Reviewed set of slides prepared by EQECAT to address Audit items.

**\*\*\*Additional Verification Review Comments\*\*\***

Reviewed model output report disclosing the structure, coverages and conditions for the secondary modifier features chosen.

**A-2 Event Definition\****(\*Significant Revision)*

- A. Modeled loss costs and probable maximum loss levels shall reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.**
- B. Time element loss costs shall reflect losses due to infrastructure damage caused by a hurricane.**

**Audit**

1. The model will be reviewed to determine that the definition of an event in the model is consistent with this standard.
2. The model will be reviewed to determine that by-passing storms and their effects are considered in a manner that is consistent with this standard.
3. The model will be reviewed to determine whether (if so, how) the model takes into account flood or hurricane storm surge.

**Verified: YES****Professional Team Comments:**

Verified no change in the definition of an event or the handling of by-passing storms in the model.

Discussed time element losses covered by policies.

Reviewed set of slides prepared by EQECAT to address Audit items.

**A-3 Modeled Loss Cost and Probable Maximum Loss Considerations**

- A. Loss cost projections and probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.***
- B. Loss cost projections and probable maximum loss levels shall not make a prospective provision for economic inflation.***
- C. Loss cost projections and probable maximum loss levels shall not include any provision for direct hurricane storm surge losses.***
- D. Loss cost projections and probable maximum loss levels shall be capable of being calculated from exposures at a geocode (latitude-longitude) level of resolution.***
- E. Demand surge shall be included in the model's calculation of loss costs and probable maximum loss levels using relevant data.***
- F. The methods, data, and assumptions used in the estimation of demand surge shall be actuarially sound.***

**Audit**

1. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, economic inflation, and any criteria other than direct property insurance claim payments.
2. The method of inclusion of secondary uncertainty in the probable maximum loss levels will be examined.
3. Provide the data and methods used to incorporate individual aspects of demand surge on personal and commercial residential coverages, inclusive of the effects from building material costs, labor costs, contents costs, repair time, etc.
4. All referenced literature will be reviewed to determine applicability.

**Pre-Visit Letter**

43.A-3, Disclosure 4, page 94: Describe the discrete calculation process cited.

**Verified: YES**

**Professional Team Comments:**

Discussed that modeled loss costs do not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin, and the model does not make a prospective provision for economic inflation.

Verified no change in the previously accepted methodology for producing probable maximum loss estimates.

Verified no change in the previously accepted methodology for demand surge calculations.

Verified that model is capable of producing loss costs and probable maximum loss costs at a geocode (latitude/longitude) level.

Reviewed the discrete calculation process and the correlation for aggregating losses. Reviewed reference documentation on-site.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.



**A-4 Policy Conditions**

- 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.***
- C. Deductible loss costs shall be calculated in accordance with s. 627.701(5)(a), F.S.***

**Audit**

1. Describe the process used to determine the accuracy of the insurance-to-value criteria in data used to develop or validate the model results.
2. To the extent that historical data are used to develop mathematical depictions of deductibles and policy limits, demonstrate the goodness-of-fit of the data to fitted models.
3. To the extent that historical data are used to validate the model results, the treatment of the effects of deductibles, policy limits, and coinsurance in the data will be reviewed.
4. Justify changes from the previously accepted submission in the relativities among corresponding deductible amounts for the same coverage.

**Verified: YES**

**Professional Team Comments:**

Reviewed the process for calculating and applying deductibles and policy limits.

Reviewed set of slides prepared by EQECAT to address Audit items.

**A-5 Coverages**

- A. The methods used in the development of contents loss costs shall be actuarially sound.***
- B. The methods used in the development of time element coverage loss costs shall be actuarially sound.***

**Audit**

The methods used to produce contents and time element loss costs will be reviewed.

**Verified: YES**

**Professional Team Comments:**

Verified no change in the previously accepted process and calculations used to develop contents and time element loss costs from the previous submission.

Reviewed set of slides prepared by EQECAT to address Audit items.

**A-6 Loss Output\***

(\*Significant Revision)

- A. The methods, data, and assumptions used in the estimation of probable maximum loss levels shall be actuarially sound.**
- B. 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.**
- C. Loss costs produced by the model shall be positive and non-zero for all valid Florida ZIP Codes.**
- 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 and appurtenant structures, contents, and time element) shall be consistent with the coverages provided.**
- I. Output ranges shall be logical for the type of risk being modeled and deviations supported.**
- J. All other factors held constant, output ranges produced by the model shall in general reflect lower loss costs for:**
  - 1. masonry construction versus frame construction,**
  - 2. personal residential risk exposure versus mobile home risk exposure,**
  - 3. inland counties versus coastal counties, and**
  - 4. northern counties versus southern counties.**

## A-6 Loss Output (Continued)

***K. For loss cost and probable maximum loss level estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) coinsurance, (4) contractual provisions, and (5) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be appropriate based on the type of risk being modeled.***

### Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-8.
2. All referenced literature will be reviewed to determine applicability.
3. Graphical representations of loss costs by ZIP Code and county will be reviewed.
4. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.
5. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-6, and A-7 will be used to assess coverage relationships.
6. The total personal and commercial residential insured losses provided in Forms A-2 and A-3 will be reviewed individually for total personal residential and total commercial residential insured losses.
7. Forms A-4 and A-5 will be reviewed, including geographical representations of the data when applicable.
8. Justify all changes in loss costs from the previously accepted submission.
9. Form A-4 will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.
10. Anomalies in the output range data will be reviewed and shall be justified.

### Pre-Visit Letter

42. Provide detailed results for Monroe County at the ZIP Code level for all Actuarial forms.
44. Form A-5, pages 216-220: Explain anomalies in the northern part of the state (e.g., page 217 Taylor, Lafayette, Suwannee counties).

45. Form A-6: Describe the process and provide the documentation for all steps to complete Form A-6. Describe steps taken to ensure the sensibility of the results.
46. Form A-7, pages 222-230: Describe the process and provide the documentation for all steps to complete Form A-7. Describe steps taken to ensure the sensibility of the results.

**Verified:    NO    YES**

**Professional Team Comments:**

This standard cannot be verified pending verification of Standard V-3.

Reviewed revised Forms A-1, A-2, A-3, A-6 and A-7 provided on site.

Reviewed Forms A-4, A-5, and A-8 as submitted.

Reviewed Forms A-1, A-3, A-4, A-5, A-6, A-7, and A-8 completed for Monroe County at the ZIP Code level.

Reviewed results provided in Form A-4 for average frame owners in comparison to masonry, masonry condo unit, and commercial residential by county and statewide.

Reviewed frame and masonry results for Monroe County at the ZIP Code level in Forms A-1 and A-4.

Reviewed results provided in Form A-4 for Calhoun County in comparison to neighboring counties. Discussed the impact on the loss costs of the quality factors year of construction, structure type, and mitigation features provided in the FHCF exposure data.

Discussed with Laura Maxwell, consulting actuary, her review of the loss costs results and inquiries into unusual results.

Reviewed the loss costs in northeast and north-central Florida and the effect of deductibles applied to low damages caused by low winds.

Reviewed table of exposure distribution by ZIP Code for frame renters, masonry renters, frame condos, and masonry condos.

Reviewed maps depicting percent change in loss costs due to the base storm update and the ZIP Code centroid update for Taylor, Lafayette, and Suwannee Counties.

Reviewed the process and steps taken to complete Form A-6 and Form A-7.

Reviewed in detail percentage changes provided in Form A-7.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Reviewed Form A-1 results for mobile home, masonry, and frame in ZIP Codes 33036 and 33139. Discussed reasons for wood frame losses decreasing while mobile home losses increased.

Reviewed Form A-1 results for frame, masonry, and mobile home by year of construction for ZIP Codes 32137, 33848, 32158, 34758, 32830, and 32159. Discussed reasons for mobile home losses less than frame losses in these ZIP Codes.

Reviewed plot of claims data from 2004 and 2005 for mobile home and frame structures.

Reviewed revised Form A-3 regenerated during the audit due to processing errors in assigning FHCF exposure data sites to the associated ZIP Codes.

Reviewed plots of loss costs percentage changes by ZIP Code in Monroe County due to the HURDAT updates for frame owners and masonry owners.

**\*\*\*Additional Verification Review Comments\*\*\***

Verified after resolution of outstanding issues with Standard V-3.

**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 statistical agreement using currently accepted scientific and statistical methods for the academic disciplines appropriate for the various model components or characteristics.*

**Audit**

1. Forms S-1, S-2, and S-3 will be reviewed. Provide justification for the distributions selected including, for example, citations to published literature or analyses of specific historical data.
2. The modeling organization's characterization of uncertainty for windspeed, damage estimates, annual loss, and loss costs will be reviewed.

**Pre-Visit Letter**

50. Form S-2, page 239: Explain how a majority of the years have no landfalling hurricanes in Florida yet the median losses are non-zero.

**Verified: YES**

**Professional Team Comments:**

Reviewed the number of historical storms in Form S-1 compared to Form M-1. The historical frequencies in Form S-1 were revised to be consistent with the 112 year period of the modeler's base hurricane storm set.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

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

*The modeling organization 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 in the appropriate disciplines and have taken appropriate action.*

### **Audit**

1. The modeling organization'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-6 will be reviewed, if applicable.

**Verified: YES**

### **Professional Team Comments:**

Verified no changes from the previous submission and no new sensitivity tests were required or performed.

Reviewed set of slides prepared by EQECAT to address Audit items.



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

*The modeling organization shall have performed an uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods in the appropriate disciplines 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 modeling organization'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-6 will be reviewed, if applicable.

**Verified: YES**

#### **Professional Team Comments:**

Verified no changes from the previous submission and no new uncertainty tests were required or performed.

Reviewed set of slides prepared by EQECAT to address Audit items.

## S-4 County Level Aggregation

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

### Audit

1. 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

47.S-4, page 120: Provide calculations that demonstrate that the sampling process error is indeed negligible.

**Verified: YES**

### Professional Team Comments:

Reviewed convergence test results for Nassau County, Taylor County, Monroe County, and statewide demonstrating that the standard errors are well less than 2.5% of the average loss costs.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

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

(\*Significant Revision)

***The model shall estimate 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 modeling organization. This standard applies separately to personal residential and, to the extent data are available, to commercial residential. 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 and shall include loss data from both 2004 and 2005.***

### 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 windfield applied to a particular hurricane for the purpose of validation and the windfield used in the model under consideration,
  - h. The type of property used in each hurricane to address:
    - (1) Personal versus commercial
    - (2) Residential structures
    - (3) Mobile homes
    - (4) Commercial residential
    - (5) Condominiums
    - (6) Structures only
    - (7) 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-4 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:**

Reviewed event optimization examples and sensitivity tests.

Reviewed comparisons in Form S-4 and their changes from the previous submission.

Reviewed set of slides prepared by EQECAT to address Audit items.

## 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-5 will be reviewed for consistency with Standard G-1, Disclosure 5.
2. Justify the following:
  - a. Meteorological parameters,
  - b. The effect of by-passing hurricanes,
  - c. The effect of actual hurricanes that had two landfalls impacting Florida,
  - d. The departures, if any, from the windfield, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration,
  - e. Exposure assumptions.

### Pre-Visit Letter

48.S-6, Disclosure 1, page 122: Provide the material alluded to in the final two paragraphs on this page.

49.S-6, Disclosure 1, page 123: Provide documentation related to the convergence tests.

**Verified: YES**

### Professional Team Comments:

Reviewed Form S-5 for consistency with overall submission and determined that the submission results were reasonable in light of model updates.

Reviewed loss costs by policy type, by region, and statewide.

Reviewed Pearson Chi-Squared goodness-of-fit test by region and several other goodness-of-fit tests.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

**COMPUTER STANDARDS – Paul Fishwick, Leader****C-1 Documentation\****(\*Significant Revision)*

- A. Model functionality and technical descriptions shall be documented formally in an archival format separate from the use of letters, slides, and unformatted text files.**
- B. The modeling organization shall maintain a primary document binder, containing or referencing a complete set of documentation specifying the model structure, detailed software description, and functionality. Development of the documentation shall be indicative of accepted software engineering practices.**
- C. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the submission shall be consistently documented and dated.**
- D. The modeling organization shall maintain (1) a table of all changes in the model from the previously accepted submission to the initial submission this year and (2) a table of all substantive changes since this year's initial submission.**
- E. 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 or reference full documentation of the software.
2. All documentation shall be easily accessible from a central location.
3. Complete user documentation, including all recent updates, will be reviewed.
4. Modeling organization personnel, or their designated proxies, responsible for each aspect of the software (i.e., user interface, quality assurance, engineering, actuarial, verification) 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 and is maintained consistently with the source code.
6. The tables specified in C-1.C that contain the items listed in Standard G-1, Disclosure 5 will be reviewed. The tables shall contain the item number in the first column. The remaining five

columns shall contain specific document or file references for affected components or data relating to the following Computer Standards: C-2, C-3, C-4, C-5, and C-6.

7. Trace the model changes specified in Standard G-1, Disclosure 5 through all Computer Standards.

### Pre-Visit Letter

51.C-1.B, page 124: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 (pages 25-26) by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

**Verified: YES**

### Professional Team Comments:

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Reviewed table of model changes since the initial submission demonstrating compliance with Computer Standards C-2 through C-6. Reviewed revised table to include file path for requirements documentation location.

Discussed documentation maintained outside of the source code.

Reviewed model documentation of the two tables required by Standard C-1.D.

Reviewed the table of changes to the model submitted as required by Standard G-1, Disclosure 5, and the table of additional changes since the initial submission. These additional changes resolve errors by (1) correctly importing of data into the correct age band, and (2) correctly migrating data when copying data between database tables.

Reviewed the visual architecture reflecting the software changes for the model, including diagrams of the client-server relations.

Reviewed model changes in the following model aspects:

1. Server (and service) configurations for applications and databases
2. Batch process functionality
3. Data flow planning and execution
4. Damage and Loss engines
5. Report generation, consistency, and maintenance

Reviewed documentation F.190 Financial Model High Level Design for dataflow separate from the PowerPoint presentation.

**\*\*\*Additional Verification Review Comments\*\*\***

Discussed with the modeler their need to continue to enhance correct, and comprehensive, correspondence among slides, equations, and computer source code. This discussion ensued after noting that while the source code implementation corresponds to the logic presented, there were some inconsistencies in the documentation. Reviewed corrected documentation for inconsistencies located via spot checks.



## C-2 Requirements

*The modeling organization shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component. Requirements shall be updated whenever changes are made to the model.*

### Audit

1. 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.

### Pre-Visit Letter

52.C-2, page 125: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5 (pages 25-26).

**Verified: YES**

### Professional Team Comments:

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Reviewed revised requirements documentation, Requirements USWIND 2013, for changes in EQECAT Florida Hurricane Model 2013a.

Reviewed requirements associated with an error discovered by the modeler after the initial model submission. The error was associated with a migration from database tables in an effort by the modeler to create more humanly readable database table names and field names within the tables.

### C-3 Model Architecture and Component Design

*The modeling organization 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, shall be available for the review of each component.

**Verified: YES**

#### Professional Team Comments:

Reviewed set of slides prepared by EQECAT to address Audit items.

Reviewed the flowchart defining the quality assurance testing for form generation associated with the modeler submission.

Reviewed the flowchart defining how the modeler assures correspondence and consistency among documents, slides, and source code.

Reviewed a revised flowchart defining the process used by the modeler to produce Form V-1, One Hypothetical Event, Form V-2, Mitigation Measures – Range of Changes in Damage, Form A-6, Logical Relationship to Risk, and Form A-7, Percentage Change in Logical Relationship to Risk.

Reviewed the flowchart defining how the vulnerability functions are derived and implemented.

## **C-4 Implementation**

- A. The modeling organization shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.**
- B. The modeling organization 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 modeling organization 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 explanatory 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.**
- F. The modeling organization shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosure 5:**
  - 1. A list of all equations and formulas used in documentation of the model with definitions of all terms and variables.**
  - 2. A cross-referenced list of implementation source code terms and variable names corresponding to items within F.1.**

## **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:
  - a. Component name,

- b. Date created,
  - c. Dates modified and by whom,
  - d. Purpose or function of the component,
  - e. 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, consistency, and explanatory quality.

**Verified:    NO    YES**

**Professional Team Comments:**

This standard cannot be verified pending verification of Standard V-3.

Reviewed set of slides prepared by EQECAT to address Audit items.

Reviewed software implementation changes to improve scalability, separate damage and loss engines, universalize damage engines, re-implement the financial model, and implement 3G correlation. The overall user interaction was changed including output of year loss tables.

Reviewed the table of software components containing lines of code and comments as prescribed in Standard C-4.D.

Reviewed the SQL script used for data migration between the old structural feature data tables and the updated tables.

Reviewed C++ source code for performing loss calculation, including handling of policy deductibles and limits.

Reviewed the modified source code used to process the Florida Cat Fund data to assign an updated quality factor computation based on an internal modeler review of the methodology for assigning quality factors.

Reviewed SQL query for selecting vulnerability function weights mapping for processing company exposure structure types.

Reviewed in detail data input file with changes to the secondary modifiers used in completing Form V-1.

Reviewed data flow diagram for calculating primary damage.

Reviewed C++ source code for scoring secondary structural modifiers.

**\*\*\*Additional Verification Review Comments\*\*\***

Verified after resolution of outstanding issues with Standard V-3.

Reviewed Total Score Computation Flow Chart for the five secondary structural modification systems.

Reviewed C++ source code for selecting secondary structural modifiers.

Reviewed C++ source code for modifying damage calculations based on the probabilistic quality factor.

Reviewed C++ source code for corrections to secondary modifier scores for “double dip” factors, (e.g., two mitigation factors are applicable and a method is used to select one factor).

Reviewed C++ source code for building code enforcement factor.

Reviewed C++ source code for interaction calculations for secondary structural modifiers.

Reviewed C++ source code for completing Form V-2. Discussed that a new code project was created rather than using a revision of prior code.

**C-5 Verification\****(\*Significant Revision)***A. General**

*For each component, the modeling organization shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeling organization personnel other than the original component developers.*

**B. Component Testing**

- 1. The modeling organization 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 model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.*

**C. Data Testing**

- 1. The modeling organization shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.*
- 2. The modeling organization 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 modeling organization will be reviewed.*

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.
4. Crosschecking procedures and results for verifying equations will be reviewed. Examples include mathematical calculations versus source code implementation, or the use of multiple implementations using different languages.
5. Flowcharts defining the processes used for manual and automatic verification will be reviewed.
6. The response to Disclosure 1 will be reviewed.

### Pre-Visit Letter

53.C-5, page 129: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5 (pages 25-26).

**Verified:    NO    YES**

### Professional Team Comments:

This standard cannot be verified pending verification of Standard V-3.

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Reviewed verification procedures and loss cost changes from the model changes identified in Standard G-1, Disclosure 5.

Reviewed the modeler's use of two different computer languages to cross-check model calculations.

Discussed with the modeler their use of different teams of personnel when doing cross-checking verifications.

Reviewed the quality assurance tests to ensure that the architectural updates and improvements to the model did not cause model data for structural features to differ from the model prior to the updates.

Discussed with the modeler their use of Excel spreadsheet testing to verify a logical relationship to risk for the model.

Reviewed the verification checks used for geographic information system (GIS) processing.

Reviewed sampling and correlation testing procedures including regression, component, unit, integration, and performance testing.

**\*\*\*Additional Verification Review Comments\*\*\***

Discussed face validation approaches in verifying changed or updated code.

Verified after resolution of outstanding issues with Standard V-3.



## C-6 Model Maintenance and Revision

- A. The modeling organization 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 modeling organization shall use tracking software to identify all errors, as well as modifications to code, data, and documentation.*
- D. The modeling organization shall maintain a list of all model versions since the initial submission for this year. Each model description shall have a unique version identification, and a list of additions, deletions, and changes that define that version.*

### Audit

1. All policies and procedures used to maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, 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.
4. The list of all model revisions as specified in C-6.D will be reviewed.

### Pre-Visit Letter

- 54.C-6.D, page 131: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

**Verified: YES**

### Professional Team Comments:

Reviewed set of slides prepared by EQECAT to address Audit items and pre-visit letter questions.

Verified no change in the model versioning methodology.

Reviewed the model version history over the past five years, leading up to the version identified in this year's model submission.

Discussed with the modeler that since the model has changed since the original submission, the modeler has modified the model version to EQECAT Florida Hurricane Model 2013a in correspondence with their policy for model revision.

## **C-7 Security**

*The modeling organization 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 set of slides prepared by EQECAT to address Audit items.

Discussed tightening of security measures enhanced through volume encryption and auto-lock on screen savers.