Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2007 Standards

EQECAT, Inc.

On-Site Review
April 14-16, 2008

Additional Verification On-Site Review
June 11-12, 2008

On April 14-16, 2008, the Professional Team visited on-site at EQECAT, Inc. (EQE) in Oakland, California. The following individuals participated in the review.

EQECAT

Shawna S. Ackerman, FCAS, MAAA, Principal and Consulting Actuary – Pinnacle Actuarial Resources, Inc.
Branimir Betov, M.S., Senior Software Engineer
Justin Brolley, Ph.D., Hazards Modeler and Research Scientist
Apoorv Dabral, Ph.D., Wind Engineering
Aarti Dinesh, Product Manager
Surya Gunturi, Ph.D., Senior Consultant
Petros G. Keshishian, Ph.D., Principal Engineer
Mahmoud M. Khater, Ph.D., P.E., Senior Vice President, Chief Science and Technology Officer
Omar Khemici, Ph.D., P.E., Director (Structural Engineering)
Dennis Kuzak
Thomas I. Larsen, Senior Vice President
Fan Lei, Ph.D., Research Scientist
Zhiyuan Liu, Ph.D., Atmospheric Scientist
David F. Smith, Senior Vice President, Technology Development and Consulting
Jie Zhou, Ph.D., Research Scientist
Qing Xia, Ph.D., Meteorologist

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 began with a discussion of the following model changes:

1. Probabilistic hurricane database regenerated, refinements in the methods used to derive probabilistic hurricane frequencies, and the recharacterization of the database in terms of 47,315 hurricane events instead of 511,500 affecting the mainland United States;
2. ZIP Code database update;
3. Land use/land cover database update;
4. Inland decay rate functions update;
5. Profile factor update to vary as a function of landfall/by-pass location for probabilistic hurricanes; and
6. Demand surge function update.

The Professional Team was unable to verify Standards M-4 (Hurricane Windfield Structure), V-1 (Derivation of Vulnerability Functions), and A-4 (Demand Surge). Consequently, the following Standards could not be verified as they require the verification of all other Standards:

G-1, G-4, G-5, C-4, and C-5. The process for responding to these findings as given in the *Report of Activities* was presented to the Modeler.

The Professional Team reviewed the following corrections to be included in the revised submission provided to the Commission prior to the May 20-22, 2008 meetings.

1. Page 12 and Page 16, G-1.2 – references to gradient to sustained winds to be removed
2. Page 20, G-1.4 – references added for land use/land cover database, 1994 and 2001 Florida Building Codes, and probabilistic hurricane frequencies
3. Page 28, G-2.2.A and B – Aarti Dinesh added
4. Page 48, M-2.1 – reference to gradient to sustained winds to be removed
5. Page 48, M-2.3 and Page 54, M-4.2 – revised to be consistent with respect to profile factor
6. Page 49, M-2.1 – removal of statement on gradient to sustained windspeed
7. Page 50, M-2.8 and M-2.10 – responses clarified
8. Page 55, M-4.8 – revised Figure 6a with additional values
9. Page 58, M-5.A – update list to include additional classifications
10. Page 59, M-5.1 – reference added for inland decay
11. Pages 60-61, M-5.2 – Figures 6b and 6c revised from knots to mph and clarification of captions
12. Page 72, V-1.A – statement on Mehta & McDonald research edited
13. Page 85, Form V-2 – revised for correct values
14. Page 92, A-3.1 – reference to gradient to sustained winds to be removed
15. Page 226, S-1.3 – table 3 revised for correct values using current model
16. Page 248, Form S-4 – value corrected for modeled AAL

Additional Verification Review – June 11 & 12, 2008

EQECAT submitted revisions to the original February 28, 2008 model submission under the 2007 Standards on May 22, 2008. The Professional Team completed the additional verification review on June 11 & 12, 2008 in Oakland. **All Standards are now verified**.

The following individuals participated in the additional verification review:

EQECAT

Shawna S. Ackerman, FCAS, MAAA, Principal and Consulting Actuary – Pinnacle Actuarial Resources, Inc.
Branimir Betov, M.S., Senior Software Engineer
Justin Brolley, Ph.D., Hazards Modeler and Research Scientist
Apoorv Dabral, Ph.D., Wind Engineering
Aarti Dinesh, Product Manager
Surya Gunturi, Ph.D., Senior Consultant
Petros G. Keshishian, Ph.D., Principal Engineer
Mahmoud M. Khater, Ph.D., P.E., Senior Vice President, Chief Science and Technology Officer
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Masoud Zadeh, Ph.D., P.E., Structural Engineer
Donna Sirmons, Staff

The review began with an overview of the additional verification review process and a recap of the previous findings from the initial on-site review on April 14-16, 2008. The Professional Team indicated it would be focusing on the changes to the model indicated in the revisions submitted on May 22, 2008 and in the responses to the deficiencies submitted on May 29, 2008.

EQECAT started with an overview of the following model updates with a discussion of their approximate impacts on the statewide average annual loss costs since the initial February 2008 submission:

- Demand surge update
- Mobile home vulnerability update (which had the largest impact on loss costs)
- Profile factor update and windfield validations.

The Professional Team reviewed the following corrections to be included in the revised submission to be provided by June 19, 2008.

1. G-1.5 – revised to include only changes in the model from the prior year's submission
2. G-1.6 – revised to include all changes in the model and the submission document since the original February 28, 2008 submission
3. Updated Certification Forms G-1, G-2, G-3, G-4, G-5, G-6, and G-7
4. M-2.3 – clarification provided on the derivation of the profile factor in the historical set
5. Form A-3 – corrected
6. Form A-4 – corrected
7. S-1.1 – updated to reflect change in profile factor to a lognormal distribution
8. S-1.3 – corrected and Table 3 values updated
9. Form S-3 – corrected and expanded
10. Form S-4 – corrected

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the March 12, 2008 meeting. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Standard M-2, Disclosure 3 (page 48)
   Functional form for the profile factor distribution not described. Provide a clear definition of profile factor and how it varies between the historical and stochastic sets.

2. Standard M-2, Disclosure 10 (page 50)
   Hurricane frequency distribution by intensity for each segment not provided.

3. Form M-2 (page 67)
   This form requires inclusion of four graphics, two each for the observed and stochastic storm sets. Only two graphics are provided in the submission and these are not adequately labeled; it is not clear whether the winds plotted correspond to open terrain or actual surface roughness distributions.

4. Form V-2 (page 85)
   Form has been completed incorrectly.

5. Form A-6A.E (pages 140-176) and Form A-6B.E (pages 177-213)
   Anomalies explained in Disclosure A-10.1 (pages 116-117) not shaded.

6. Standard A-10, Disclosures 3 & 4 (page 118)
   Provide justification for changes.

EQECAT provided updated Expert Certification Forms G-1, G-2, G-3, G-4, G-5, G-6, and G-7 in response to the deficiencies.

Additional Verification Review Comments

The Professional Team reviewed the following deficiencies cited by the Commission Chair, in consultation with SBA staff and the Professional Team, on May 28, 2008. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Standard G-1, Disclosure 6 (page 23)
   The output ranges (Forms A-6A and A6-B) have been revised which in turn cause many other Forms to be re-run.

2. Standard M-4, Form M-2 (pages 73-77)
   The maps are not completely contained in the revised submission.

3. Standard A-4, Disclosure 1 (page 103)
   The update to the demand surge function following the on-site review has generated no discussion in the revised submission.

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 Professional Team will interview the individuals signing the Expert Certification Forms G-1 through G-7.

Provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and if available, the 2005 hurricane

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

Be prepared to provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2002 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2002 FHCF exposure data. Be prepared to discuss changes in loss costs from the use of the 2007 FHCF exposure data from the loss costs produced using the 2002 FHCF exposure data.

When the Professional Team arrives on-site, a copy of Form V-3 must be available. Also provide 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.

Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since 2005 (three years prior). Be prepared to describe any processes used to amend or validate the model that incorporates this data.
NOTE: In its deliberations during the review of the EQE model for acceptability under the 2006 Standards on May 5, 2007, the Commission expressed the following:

> Windfield (Standard M-4): "I would expect that a modeling organization would keep track of the literature and be sure to read the relevant papers and certainly not something that appeared in the AMS conference last year and hasn't been peer reviewed, that we wouldn't hold them to that standard. But this is based on stuff that I studied as a graduate student a generation ago."
>
> Demand Surge (Standard A-4): "…but I would suggest that assuming this Standard is passed, that next year you consider how to improve that. If not the Standard – not the demand surge model itself, but perhaps how you got that information to us."
>
> "…we did carve out Standard A-4 to be voted on individually and in the discussion section we expressed our concern to the modeler as it relates strictly to the age of the data and the process and the like and with the hope they will come back with something better next year."

Provide to the Professional Team all materials EQE intends to present to the Commission in response to these concerns.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

1. The main intent of the audit is to determine the capabilities of the model and to assess its implementation for purposes of Florida projected loss costs. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.

2. All software located within the model, used to compile data used by the model, used to validate the model, and used to project model loss costs (1) fall within the scope of the Computer Standards, and (2) will be reviewed interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each Standard).

3. Databases or data files relevant to the modeler's submission will be reviewed.

Pre-Visit Letter

1. G-1, Disclosure 2, page 16 – Provide a detailed description of the development of the "empirical adjustment to the 'Observed/Gradient Wind Ratio'."

2. G-1, Disclosure 5, page 22 – Provide a detailed description of how changes respond to concerns expressed by the Commission at last year's acceptability meeting relative to updating the windfield and demand surge components of the model.

3. G-1, Disclosure 5, page 22 – Provide a detailed description of refinements in the methods used to derive probabilistic hurricane frequencies.

4. G-1, Disclosure 5, page 22 – Provide a detailed description of updates to the decay rate functions.

5. G-1, Disclosure 5, page 23 – Clarify the dependence of the profile factor on Rmax.

Verified: ~~**CONTINGENT UPON RECEIPT OF RESPONSE TO DISCLOSURE 6 AND COMPLETED CERTIFICATION FORMS**~~ **YES**

Professional Team Comments:

An itemized description of all substantive changes must be provided (G-1.6). Completed Certification Forms G-1, G-2, G-3, G-4, G-5, G-6, and G-7 are required.

Discussed EQECAT's views on how changes made to the model responded to the concerns expressed by the Commission at the May 5, 2007 model review meeting relative to updating the windfield and demand surge components of the model.

- Relevant updates to the model this year:
  - Profile factor assigned by landfall location based on a smoothed distribution derived from latest historical data
  - Inland decay rate factor updated with latest historical data
  - Latest HURDAT database used
  - New land use land cover data used
  - ZIP Code centroid updates
  - Probabilistic hurricane database generation
  - Demand surge update
- Personnel added to EQECAT team – several atmospheric scientists, statisticians, mathematicians, engineers, and computer scientists.

Reviewed the refinements in the methods used to derive the probabilistic hurricane frequencies. Documentation reviewed:

Chaudhuri, P. and Marron, J.S., (1999). "SiZer for Exploration of Structures in Curves," *Journal of the American Statistical Association*, Vol. 94, No. 447, Theory and Methods, pages 807-823.

Discussed the relationship between the profile factor and Rmax.

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

Reviewed revised responses to G-1.5 and G-1.6 provided during the additional verification review. In particular, the mobile home vulnerability update took place following the initial February 2008 submission. In G-1.5, the demand surge update used new data relative to the previous year's submission while the demand surge update in G-1.6 involved substantive changes to the demand surge function.

Reviewed corrected Certification Forms G-1, G-2, G-3, G-4, G-5, G-6, and G-7 during the additional verification review.

G-2 Qualifications of Modeler Personnel and Consultants

A. Model construction, testing, and evaluation shall be performed by modeler personnel or consultants who possess the necessary skills, formal education, or 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 modeler 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 be signatories on Forms G-1 through G-6 as applicable and shall abide by the standards of professional conduct if adopted by their profession.

Audit

1. The professional vitae of modeler personnel and 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 modeler personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

6. G-2, Disclosure 2.B, page 28 – Provide a curriculum vita or resume for each of the employees listed.

7. G-2, Disclosure 3.A, pages 30-31 – The disclosure only pertains to *"components as currently functioning in the model."* Hence, inclusion of the reviews given in the submission implies that none of these model components have been substantially changed in over a decade. This should be considered in light of the Commission's statements quoted above.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Justin M. Brolley, Ph.D., Meteorology, Florida State University; M.S. Meteorology, Florida State University; B.S. Meteorology, Pennsylvania State University
- Aarti Dinesh, MBA University of Missouri; Post Graduate Diploma in Financial Management, Mount Carmel Institute of Management, Bangalore, India; Bachelor in Commerce, Bishop Cottons Women's Christian College, Bangalore, India
- Parasuraman Kamban, Ph.D., Civil Engineering, University of Saskatchewan, M.E. Hydrology and Water Resources Engineering, Anna University, India; B. Tech, Civil Engineering, Pondicherry University, India
- Youngsuk Kim, Ph.D., Civil Engineering, University of Illinois at Urbana-Champaign; M.Eng. Civil Engineering, University of Seoul, Korea; B.Eng. Civil Engineering, University of Seoul, Korea
- Surya Kumar V. Gunturi, Ph.D. Civil Engineering (Structural Engineering), Stanford University, Masters in Technology in Civil Engineering (Structural Engineering), Indian Institute of Technology, Madras, India
- Fan Lei, Ph.D., Meteorology, University of Maryland; M.S. Meteorology, University of Maryland; B.S. Atmospheric Science, Nanjing University
- Yang-Wei Lin, M.S. Civil Engineering, the University of Memphis, Tennessee; B.E. Civil Engineering, Tamkang University, Taiwan
- Zhiyuan Liu, Ph.D., Applied Mathematics/Meteorology Specialization, the University of Wisconsin-Milwaukee; M.S., Applied Mathematics, the University of Wisconsin-Milwaukee; M.S. Meteorology, Chinese Academy of Meteorological Science; B.S. Meteorology, Beijing Institute of Meteorology
- Jose Miranda, M.S. Atmospheric Science (pending), University of Missouri; B.A. Communications, Minor in Mathematics, Elizabethtown College
- Vinh K. Thach, B.S. Computer Science and Engineering, UC Davis.
- Jingyun Wang, Ph.D., Department of Geography and Environment, Boston University; M.S. Atmospheric Science, University of Wyoming; M.S. Atmospheric Physics and Atmospheric Environment, Peking University; B.S. Atmospheric Physics and Atmospheric Science, Lanzhou University
- Kunshan Yin, Ph.D., Statistics, the University of Texas at Dallas; M.S. Statistics, the University of Texas at Dallas; M.S. Economics, Nanjing University of China; B.S. Computational Mathematics, Shandong University of China
- Jie Zhou, Ph.D., Statistics, University of North Carolina at Chapel Hill; B.S. Mathematics, University of Science and Technology of China

Verified that no former employees left for violation of professional ethical standards.

EQECAT stated that the reviews given in the submission are still relevant. Discussed removal of the references under Disclosure 3.A.

G-3 Risk Location

A. ZIP Codes used in the model shall be updated at least every 24 months using information originating from the United States Postal Service. The United States Postal Service issue date of the updated information shall be reasonable.

B. ZIP Code centroids, when used in the model, shall be based on population data.

C. ZIP Code information purchased by the modeler shall be verified by the modeler for accuracy and appropriateness.

Audit

1. Provide geographic displays for all ZIP Codes. The location of specific centroids will be reviewed.

2. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.

Pre-Visit Letter

8. G-3, Disclosure 2, pages 33-34 – Provide examples of ZIP Code error checking referenced.

Verified: YES

Professional Team Comments:

Reviewed details of the ZIP Code database update. Reviewed graphical presentation of ZIP Code centroid movements in the new database. Examined selected ZIP Codes based on land use land cover examination.

Reviewed changes in the current ZIP Code database release.

Reviewed the process for validating ZIP Codes on data provided by vendor.

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 and loss costs). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model would not meet this Standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.

2. Describe all changes in the model since the previous submission that might impact the independence of the model components.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Reason for non-verification: Unable to verify pending verification of Standards M-4, V-1, and A-4.

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

No bias detected among the meteorological, vulnerability, and actuarial components of the model.

G-5 Editorial Compliance*

*(*New Standard)*

All documents 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.

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 November 1, 2007*.

2. Describe all changes to the submission document since the prior year's submission that might impact the final document submission.

3. Demonstrate that the modeler submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and error free regarding the inclusion of extraneous data or materials. Form G-7 will be reviewed.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Reason for non-verification: Unable to verify pending verification of Standards M-4, V-1, and A-4.

Discussed with David Smith his process for editorial review.

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 were identified. The modeler is responsible for eliminating such errors.

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

Additional editorial items noted by the Professional Team were satisfactorily addressed during the additional verification review. The Professional Team cannot guarantee that all editorial difficulties were identified. The modeler is responsible for eliminating such errors.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 1, 2007 (or later), HURDAT as of June 1, 2005 plus the 2005 and 2006 seasons, or HURDAT as of June 1, 2006 plus the 2006 season. 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. Validation and comparison shall encompass the complete Base Hurricane Storm Set as well as any partitions.

Audit

1. The modeler's Base Hurricane Storm Set will be reviewed.

2. Reasoning and justification underlying any modification by the modeler to the Base Hurricane Storm Set will be reviewed.

3. Reasoning and justification underlying any short-term and long-term variations in annual storm frequencies incorporated in the model will be reviewed.

4. 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.

5. 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

22. Form M-1, pages 63-64 – Provide the method used to calculate the "Entire State Modeled" values presented.

Verified: YES

Professional Team Comments:

Verified that the June 2007 version of HURDAT for years 1900-2006 and the 2007 hurricane season was incorporated for Florida and adjacent states.

Confirmed that no differential weighting or partitions were used in developing the historical landfall frequency by category.

Reviewed Form M-1. By-passing storms were excluded from the calculations except where appropriate. Discussed values for adjacent states and impacts of smoothing.

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

Discussed why the modeler did not show a change in Form M-1 after a change in the profile factor.

Discussed lack of change to by-passing storm statistics relative to significant digits required in Form M-1.

M-2 Hurricane Parameters and Characteristics*

*(*Significant Revision due to new Disclosures and Audit language)*

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, strike probabilities, tracks, the spatial and time variant windfields, and conversion factors, shall be based on information documented by 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:
   - the data set basis for the fitted distributions,
   - the modeled dependencies among correlated parameters in the windfield component and how they are represented,
   - the asymmetric nature of hurricanes,
   - the fitting methods used and any smoothing techniques employed.

3. The goodness-of-fit of distributions to historical data will be reviewed.

4. The treatment of uncertainties associated with the conversion of gradient winds to surface winds will be compared with currently accepted literature. Variation of the conversion factor with storm intensity will be reviewed.

5. All modeler cited scientific literature provided in Standard G-1 will be reviewed to determine applicability.

6. All external data sources that affect model generated windfields will be identified and their appropriateness will be reviewed.

7. 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

9. M-2, Disclosure 1, pages 47-48 – Describe the profile factor distribution and sampling methodology used for stochastic storms. Describe the evidence used to impose an upper bound on the profile factor based on Rmax.

10. M-2, Disclosure 1, page 48 – Describe how gradient to sustained wind speed is used in the model with reference to the discussion on page 49, Disclosure 5.

11. M-2, Disclosure 8, pages 49-50 – Provide the additional data sources used for distributions of track direction at landfall.

Verified: YES

Professional Team Comments:

Reviewed the method of derivation of the profile factors for a subset of historical storms based on TPC/NHC marine advisories corrected for storm motion.

Discussed the range of profile factors for historical storms compared to the range used in the stochastic set.

Verified that an additional multiplier for gradient to sustained windspeed is not used in the current model. All references to the gradient to sustained winds will be removed in the submission.

Confirmed that no additional data sources were used for track direction at landfall.

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

Discussed revised treatment of profile factor as a stochastic variable.

Discussed development of profile factor ranges by landfall location.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

A. Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.

B. Modeled hurricane probabilities 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).

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 modeler specific research performed to develop the functions used for simulating model variables or to develop databases.

Verified: YES

Professional Team Comments:

Reviewed modeler-specific research relevant to profile factor and to decay rate.

Confirmed that the profile factor was not probabilistic in the stochastic storm set.

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

Reviewed distributions of profile factor by region.

Reviewed historical data underlying distributions.

M-4 Hurricane Windfield Structure*

*(*New Standard)*

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 to geographic surface roughness distribution shall be consistent with current state-of-the-science.

Audit

1. Provide any modeler-specific research performed to develop the windfield functions used in the model. Identify the databases used.

2. Provide any modeler-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, Hurricane Katrina, and Hurricane Wilma.

6. For windfield and/or pressure distributions not previously reviewed, the modeler will present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable windfield characteristics.

7. Form M-2 will be reviewed.

Pre-Visit Letter

12. M-4, Disclosure 1, page 53 – Justify the choice of the windfield formulation.

13. M-4, Disclosure 1, page 53 – Provide a detailed description of the derivation of the minimum, mean, and maximum profiles used in Florida in the current submission.

14. M-4, Disclosure 2, page 54 – Provide examples of wind radii corresponding to five different (Vmax, Rmax) combinations for both the maximum and minimum profile factor used for the stochastic storm windfield, demonstrating consistency with Form M-3.

15. M-4, Disclosure 6, page 54 – Describe the process used to ensure the quality of the new land use/land cover database and its implementation.

16. M-4, Disclosure 8, page 55 – Provide examples of spatial windfield validation for Hurricanes Charlie and Katrina.

17. M-4, Disclosure 8, page 55 – Provide observed values not included on the plot in Figure 6a.

18. M-4, Disclosure 9, page 56 – Provide the profile factors for the three example storms (Hurricanes Charley, Katrina, and Wilma). State whether these profile factors are in the range possible for stochastic storms.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

The Modeler did not provide sufficient detailed analyses of windfields from recent storms to justify the continued use of the functional form of the Modeler's windfield.

Reviewed the update to the profile factor from a constant for all stochastic storms to a variation on landfall location. Reviewed the data used to justify the Rmax-based cap on profile factor. The distribution of profile factor varies smoothly with landfall location.

Discussed the derivation of the minimum, mean, and maximum profile factors in Figure 5 on page 53 of the submission.

Discussed data sources and how the profile factors were derived.

Reviewed computer code for computing the profile factor for historical storms.

Process for assignment of profile factors for potential by-passing storms was not discussed.

Reviewed map depicting the profile factor values for the stochastic storm set for Florida and adjacent states.

Reviewed plot of wind profile for 10 hypothetical Florida hurricanes (5 Rmax & Vmax combinations for maximum and minimum profile factors).

Relative to M-4.3, page 54, reviewed spatial windfield comparisons from plots of the model-generated winds versus AOML/H*Wind for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005) focusing on the relative extents of damaging winds.

Reviewed revised Figure 6a with additional values for Hurricane Wilma (2005). Confirmed that the observations are derived from NHC reports.

Reviewed the modeled profile factors for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005) with respect to their landfall locations.

Discussed the modeler's concern about the reliability of over-land observations in the strong wind region.

Reviewed sensitivity test on the profile factor.

Reviewed the land use land cover database update to the 30-meter resolution data acquired from the National Land Cover Database (NLCD 2001).

Discussed the implementation and testing of the land use land cover dataset for potential problems with invalid and unreasonable values.

Reviewed map summarizing the ratio between the updated and the original version of the land use land cover database. Discussed procedures used to ensure that the correct database was incorporated into the model.

Reviewed documentation on the land use land cover dataset implementation. Reviewed the input file containing the land use codes and corresponding friction factors. Verified no change was made to the process, only a new dataset was used.

Discussed the process used for assigning friction factors. Discussed the mapping of the old and new land use land cover categories to the friction factors used in the model.

Reviewed computer code for converting the land use land cover data and the Excel spreadsheet with final land use land cover codes.

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

Reviewed the revision to the profile factor. In the original February 2008 submission, the profile factor was treated deterministically at any given landfall or by-passing location. The revised profile factor is treated as a random variable from a probabilistic distribution dependant on landfall location.

Reviewed the profile factor reduction for Hurricane Wilma (2005).

Reviewed validation test for modeled and observed wind gusts.

Reviewed revised wind profile for average Florida hurricane with an Rmax of 20 miles and a maximum windspeed of 105 mph. The mean profile factor changed from 1.09 to 1.16.

Reviewed Kolmogorov-Smirnov tests of the revised profile factor (1) at one location (Miami, FL), (2) for the entire state of Florida, and (3) for the entire United States for the stochastic set versus historical storms.

Reviewed results of Shapiro-Wilks normality test on the revised profile factor.

The log-normal profile factor distribution now allows the range of profile factors in stochastic storms to include the range of profile factors for historical storms.

Reviewed plots of windfield evaluations for Hurricane Opal (1995), Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005) (updated profile).

Reviewed results of Kolmogorov-Smirnov tests on the modeled and observed windspeeds for Hurricane Opal (1995), Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Katrina (2005), and the updated profile Hurricane Wilma (2005).

Discussed the change in the mean profile factor relative to the historical storms.

Reviewed storms contributing to Miami profile factor distribution.

Reviewed tracks for all storms contributing to profile factor around the state. Discussed method for determining regional profile factor distributions.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

A. The magnitude of land friction coefficients shall incorporate current geographic surface roughness distributions and shall be implemented with appropriate geographic information system data.

B. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records.

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 strike probabilities as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter 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. 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.

Pre-Visit Letter

19. M-5, Disclosure 2, pages 60-61 – Specify exactly what is plotted here. The text states on page 61, Disclosure 4 that Pmin is specified for observed storms over land and that storm parameters are specified (fitted) for observed storms. Given this, provide justification for the differing observed and modeled wind speeds in these plots.

20. M-5, Disclosure 2, page 60 – Provide plots of the modeled degradation rates for Hurricanes Charley, Katrina, and Wilma.

21. M-5, Disclosure 3, page 61 – Provide the formula for the over-water to over-land transition and justify its form.

Verified: YES

Professional Team Comments:

Reviewed scatter plots comparing new filling rate factors to the previous filling rate factors for hurricanes making landfall in Florida and making landfall in the Gulf Coast.

Discussed the differing windspeeds for the observed and modeled winds in the degradation rate plots in Figures 6b and 6c (pages 60-61). Clarified the plots depict the probabilistic decay rate. Discussed the different observation values used compared to previous submission.

Reviewed plots of the modeled degradation rates for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005).

Reviewed the formula for calculating the over-water to over-land transition based on NWS-23 which accounts for smooth deceleration of wind as the storm crosses over coastal areas.

Reviewed maps depicting spatial distributions of the old and new decay rate differences.

Reviewed documentation of inland decay relevant to computer code.

Reviewed computer code for calculating filling rate factors.

Reviewed table of rapidly decaying storms in Florida.

Reviewed goodness-of-fit test on the filling rate factors for the Florida Peninsula and the Gulf Coast.

Reviewed the individual impact of the filling rate update on loss costs by county.

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

Discussed diagnostics of modeled and observed windspeed differences over land.

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 modeler's sensitivity analyses provide the information used in auditing this Standard.

2. Justify the relationship between central pressure and radius of maximum winds.

Verified: YES

Professional Team Comments:

Reviewed results provided in Form M-3.

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

Reviewed revised Form M-3. Discussed changes related to new probabilistic treatment of profile factor. Discussed unchanged plot since Rmax values unchanged.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions

A. Development of the vulnerability functions is to be based on a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. Any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, or historical data.

B. The method of derivation of the vulnerability functions shall be theoretically sound.

C. Any modification factors/functions to the vulnerability functions or structural characteristics and their corresponding effects shall be clearly defined and be theoretically sound.

D. Construction type and construction characteristics shall be used in the derivation and application of vulnerability functions.

E. In the derivation and application of vulnerability functions, assumptions concerning building code revisions and building code enforcement shall be justified.

F. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and additional living expense.

G. The minimum windspeed that generates damage shall be reasonable.

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. To the extent that historical data are used to develop vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete structural calculations shall be presented so that a variety of different structure types and construction characteristics may be selected for review. The basis for expert opinion and original site inspection reports 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 additional living expense 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, and provide validation of the range and direction of the variations in damage.

5. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement.

6. Provide validation material for the disclosed minimum windspeed. Provide the computer code showing the inclusion of the minimum windspeed at which damage occurs.

7. Form V-1 will be reviewed.

Pre-Visit Letter

23. V-1, Disclosure 1, page 74 – Provide an example application of the process by which the vulnerability functions are derived, e.g. for a wood frame or mobile home construction class.

24. V-1, Disclosure 2, pages 74-75 – Demonstrate how new claims data validated the vulnerability functions for mobile homes.

26. Form V-1.B, page 81 – Demonstrate the computer methodology used to complete this form including the input and output files.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

When discrepancies between the existing mobile home vulnerability functions and the data were identified by EQECAT, the data were assumed to be in error. We were thus unable to verify this Standard.

Reviewed validation process of vulnerability functions for mobile homes. Reviewed plot with 90% confidence interval on observed damage for mobile homes.

Reviewed flowchart on the process for the derivation of the vulnerability functions.

Verified the base vulnerability functions have not been revised since the previous submission.

Discussed the process for reviewing insurance claims data for validating the vulnerability functions.

Discussed the process and data files used to complete Form V-1. Verified that one-minute sustained windspeeds were used.

Discussed year of construction as a modifier to the base vulnerability curve, which corresponds to building code revisions.

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

Reviewed the new vulnerability function for mobile home with tied downs. Reviewed the underlying claims data. There was no assumption that claims data were erroneous.

Reviewed impact on statewide annual average loss costs of revised mobile home vulnerability function.

Reviewed plots of untied mobile home and old and new tied down mobile home vulnerability functions. Reviewed plot of best fit and old and new vulnerability functions for mobile homes with tied downs together with underlying claims data.

Verified that proper portion of data set was used to develop vulnerability function for the mobile home with tied downs.

Reviewed code implementing tied down mobile home vulnerability function.

Reviewed code for assessing the impact of year of construction on vulnerability function.

The Professional Team advised the modeler, with respect to the masonry and frame vulnerability functions, it is expected the 2004 and 2005 claims data will be reviewed for validation and updating the model if required next year.

V-2 Mitigation Measures

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

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

B. Application of mitigation measures shall be empirically justified both individually and in combination.

Audit

1. Forms V-2 and V-3 provide the information used in auditing this Standard.

2. Individual mitigation measures as well as total 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

25. V-2, Disclosure 3, page 79 – Discuss "scoring system" used to rate mitigation measures.

Verified: YES

Professional Team Comments:

Reviewed the methodology for secondary modifiers used to adjust the base vulnerability curve.

Reviewed the process for ensuring no double counting of mitigation measures.

Reviewed results provided in Form V-2 and Form V-3 (Trade Secret List). Confirmed with actual calculations that the revised Form V-2 values were consistent with the values in Form V-3. Reviewed spreadsheets used to generate Forms V-2 and V-3.

Reviewed the variation of impact of mitigation with windspeed.

Reviewed the impact and mitigation schemes individually and in combination.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs

Modeled loss costs shall reflect all damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.

Audit

1. The model will be reviewed to determine that the definition of an event in the model is consistent with Standard A-1.

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

Verified: YES

Professional Team Comments:

Verified no change in the model definition of landfalling hurricanes and by-passing hurricanes.

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

Discussed that new treatment of profile factor did not impact the by-passing storm counts to accuracy of Form M-1.

A-2 Underwriting Assumptions

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

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

Audit

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

Pre-Visit Letter

27. A-2.B, pages 87-88 – Provide available insurance claims data referenced, including the latest two years of data used in the described process.

Verified: YES

Professional Team Comments:

Discussed insurance data used in validation and the latest data for the 2004 and 2005 storms.

Reviewed the 90% confidence band of the mean damage ratio from the 2004 and 2005 claims data for masonry building structures in Florida.

A-3 Loss Cost Projections

A. Loss cost projections produced by hurricane loss projection models shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

B. Loss cost projections shall not make a prospective provision for economic inflation.

Audit

1. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, and economic inflation.

Verified: YES

Professional Team Comments:

Verified no change in the method for producing loss costs based on insurance company claims data.

A-4 Demand Surge

A. Demand surge shall be included in the model's calculation of loss costs using relevant data.

B. The methods, data, and assumptions used in the estimation of demand surge shall be actuarially sound.

Audit

1. Provide the data and methods used to determine the effects of demand surge.

2. All referenced literature will be reviewed to determine applicability.

Pre-Visit Letter

28. A-4, page 92 – Provide detailed description of demand surge calculation process.

29. A-4, page 92 – Describe and provide examples of studies or analyses performed using data from 2004 or later storms to validate the EQE demand surge functions and calculations.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Reviewed and discussed in detail the update to the Demand Surge function.

As stated in the EQECAT submission, the demand surge calculation "is determined using the building materials inventory available in the affected region…"

Reviewed plot of wage and inventory correlation for a consistent set of stores as basis for their assumptions.

Demand surge model basis as presented by the modeler provided insufficient substantiation that the method appropriately considers the following:

1. increased construction labor costs
2. increased labor transportation costs
3. increased labor housing costs.

Reviewed comparison of modeled losses and actual claims data for Hurricane Opal (1995), Hurricane Andrew (1992), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Charley (2004), Hurricane Frances (2004), and Hurricane Wilma (2005).

Internal documentation reviewed.

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

Reviewed the revised demand surge methodology and calculations which consider both building materials cost and construction labor wages.

The Professional Team contended that demand surge would result from several storms in one area in a season. EQECAT's analysis of claims data shows no demand surge from 2004 claims data except for Hurricane Ivan (2004) claims, and that there was no apparent temporary increase in construction labor costs or building materials costs after the 2004 storms.

Reviewed comparisons of 2004 actual losses versus modeled losses for Hurricane Charley (2004), Hurricane Ivan (2004), and combined Hurricanes Frances and Jeanne (2004).

Reviewed the revised cap limit placed on demand surge which is now based on the observed experience in the wind damaged areas only from Hurricane Katrina (2005). The Professional Team understands the increase of this cap resulted in the increase in loss costs.

Reviewed data comparing various construction materials costs, labor costs, hotel costs, and fuel costs from 1992 and 2008.

Reviewed results of statistical analyses.

A-5 User Inputs

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

Audit

1. Quality assurance procedures shall include methods to assure accuracy of insurance data. Compliance with this Standard will be readily demonstrated through documented rules and procedures.

2. All insurer inputs and assumptions will be reviewed.

Verified: YES

Professional Team Comments:

Verified no change in the methodology from the previous submission.

Reviewed how the new FHCF exposure data was processed and input into the model.

A-6 Logical Relationship to Risk

A. Loss costs shall not exhibit an illogical relation to risk, nor shall loss costs exhibit a significant change when the underlying risk does not change significantly.

B. Loss costs produced by the model shall be positive and non-zero for all valid Florida ZIP Codes.

C. Loss costs cannot increase as the quality of construction type, materials and workmanship increases, all other factors held constant.

D. Loss costs cannot increase as the presence of fixtures or construction techniques designed for hazard mitigation increases, all other factors held constant.

E. Loss costs cannot increase as the quality of building codes and enforcement increases, all other factors held constant.

F. Loss costs shall decrease as deductibles increase, all other factors held constant.

G. The relationship of loss costs for individual coverages, (e.g., structures and appurtenant structures, contents, and loss of use/additional living expense) shall be consistent with the coverages provided.

Audit

1. Graphical representations of loss costs by ZIP Code and county will be reviewed.

2. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.

3. Individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, and A-5 will be used to assess coverage relationships.

Pre-Visit Letter

31. Form A-5, pages 138-139 – The form will be reviewed in detail.

Verified: YES

Professional Team Comments:

Reviewed in detail the results provided in Form A-5.

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

Reviewed corrected Forms A-3 and A-4. Revised forms did not exhibit illogical relations to risk.

A-7 Deductibles and Policy Limits

A. The methods used in the development of mathematical distributions to reflect the effects of deductibles and policy limits shall be actuarially sound.

1. The relationship among the modeled deductible loss costs shall be reasonable.

2. 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. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for handling deductibles and policy limits.

3. To the extent that historical data are used to develop mathematical depictions of deductibles and policy limit functions, demonstrate the goodness-of-fit of the data to fitted models.

4. Justify changes from the prior submission in the relativities among corresponding deductible amounts for the same coverage.

Pre-Visit Letter

30. A-7, Disclosure 2, pages 109-111 – Provide material cited to confirm or validate the method used by the model.

Verified: YES

Professional Team Comments:

Verified no change in the loss elimination ratios.

Discussed the use of the references provided on pages 110-111 under Table 2 as the actuarial basis for the application of deductibles and limits.

A-8 Contents

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

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

Audit

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for contents coverage.

2. 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.

3. Justify changes from the prior submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Verified: YES

Professional Team Comments:

Verified no change in handling contents losses.

A-9 Additional Living Expense (ALE)

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

B. ALE loss cost derivations shall consider the estimated time required to repair or replace the property.

C. The relationship between the modeled structure and ALE loss costs shall be reasonable, based on the relationship between historical structure and ALE losses.

D. ALE loss costs produced by the model shall appropriately consider ALE claims arising from damage to the infrastructure.

Audit

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for ALE coverage. Documentation and justification of the following will be reviewed:
    a. The method of derivation and data on which the ALE vulnerability function is based;
    b. Validation data specifically applicable to ALE;
    c. Assumptions regarding the coding of ALE losses by insurers;
    d. The effects of demand surge on ALE for Hurricane Andrew;
    e. Assumptions regarding the variability of ALE by size of property;
    f. Statewide application of ALE assumptions;
    g. Assumptions regarding ALE for mobile homes, tenants, and condo unit owners exposure;
    h. The methods used to incorporate the estimated time required to repair or replace the property;
    i. The methodology and available validation for determining the extent of infrastructure damage and its effect on ALE costs.

2. To the extent that historical data are used to develop mathematical depictions of ALE functions, demonstrate the goodness-of-fit of the data to fitted models.

3. Justify the differences in the relationship of structure and ALE loss costs from those previously found acceptable.

Verified: YES

Professional Team Comments:

Verified no change in handling ALE losses.

A-10 Output Ranges

A. Output ranges shall be logical and any deviations supported.

B. All other factors held constant, output ranges produced by the model shall reflect lower loss costs for:

1. masonry construction versus frame construction,

2. residential risk exposure versus mobile home risk exposure,

3. in general, inland counties versus coastal counties, and

4. in general, northern counties versus southern counties.

Audit

1. Forms A-6A, A-6B, A-7, and A-8 will be reviewed.
2. The modeler will be required to justify all changes from the prior submission using the 2002 Florida Hurricane Catastrophe Fund aggregate exposure data.
3. Output ranges will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.
4. Anomalies in the output range data will be reviewed and shall be justified.

Verified: YES

Professional Team Comments:

Reviewed Output Ranges.

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

Reviewed revised Output Ranges.

Reviewed revised Form A-7 and the impact on the statewide average annual loss costs for each update to the model since the initial February 2008 submission.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

A. The use of historical data in developing the model shall be supported by rigorous methods published in currently accepted scientific literature.

B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods in the appropriate disciplines.

Audit

1. Forms S-1 and S-2 will be reviewed.

2. The modeler's characterization of uncertainty for windspeed, damage estimates, annual loss, and loss costs will be reviewed.

Pre-Visit Letter

32. S-1, Disclosure 2, page 225 – Provide data used in addition to NWS-38 for storm characteristics.

33. S-1, Disclosure 2, page 225 – Demonstrate that the landfall frequency and intensity distributions used in the model are based on the November 1, 2006 Florida storm set.

34. S-1, Disclosure 3, page 226 – Provide sources for actual peak gust observations and discuss their relationship to the actual peak winds in the storm.

Verified: YES

Professional Team Comments:

Reviewed results provided in Table 3, Comparison of Point Location Observations with Model-Generated Winds, on page 226. Values in Table 3 were not updated from the previous submission. A corrected Table will be provided in the revised submission.

Reviewed several other fitted models and their goodness-of-fit in the course of the audit.

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

Reviewed several iterations of Table 3.

The lognormal distribution fit to the profile factor was independently verified by the Professional Team.

Reviewed the fitting process for the revised mobile home vulnerability function.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

2. Form S-5 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Pre-Visit Letter

35. S-2, Disclosure 1, page 230 – Describe sensitivity analyses performed on the profile factor.

Verified: YES

Professional Team Comments:

Reviewed sensitivity analyses performed on the profile factor.

S-3 Uncertainty Analysis for Model Output

The modeler shall have performed an uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods 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 modeler's uncertainty analysis will be reviewed in detail. Statistical techniques used to perform uncertainty analysis shall be explicitly stated. The results of the uncertainty analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

2. Form S-5 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Pre-Visit Letter

36. S-3, Disclosure 1, page 233 – Describe uncertainty analyses performed on the profile factor.

Verified: YES

Professional Team Comments:

No change to Form S-5.

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

37. S-4, page 235 – Provide details of the process used to arrive at the 47,315 simulation runs.

Verified: YES

Professional Team Comments:

Verified that 47,315 events were adequate.

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

Verified that the number of events was adequate.

S-5 Replication of Known Hurricane Losses

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 modeler. This Standard applies separately to personal residential and, to the extent data are available, to mobile homes. Personal residential experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail.

Audit

1. The following information for each insurer and hurricane will be reviewed:
   a. The validity of the model assessed by comparing expected losses produced by the model to actual observed losses incurred by insurers at both the state and county level,
   b. The version of the model used to calculate modeled losses for each hurricane provided,
   c. A general description of the data and its source,
   d. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
   e. The date of the exposures used for modeling and the date of the hurricane,
   f. An explanation of differences in the actual and modeled hurricane parameters,
   g. A listing of the departures, if any, in the 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:
      i. Personal versus commercial
      ii. Residential structures
      iii. Mobile homes
      iv. Condominiums
      v. Structures only
      vi. Contents only,
   i. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.

2. The following documentation will be reviewed:
   a. Publicly available documentation referenced in the submission,
   b. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
   c. An analysis that identifies and explains anomalies observed in the validation data,
   d. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

3. The confidence intervals used to gauge the comparison between historical and modeled losses will be reviewed.

4. Form S-3 will be reviewed.

5. The results of one hurricane event for more than one insurance company and the results from one insurance company for more than one hurricane event will be reviewed to the extent data are available.

Pre-Visit Letter

38. S-5, Disclosure 1, page 236 – Describe the use of the 2004 and 2005 storm loss data to alleviate concerns expressed due to the use of only Hurricane Andrew data.

Verified: YES

Professional Team Comments:

Discussed the analysis of the 2004 and 2005 storms loss data in addition to Hurricane Andrew loss data for validation.

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

Reviewed revised Form S-3.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-4 will be reviewed.

2. Justify the following:
   a. Meteorological parameters,
   b. The effect of by-passing storms,
   c. The effect of actual hurricanes that had two landfalls impacting Florida,
   d. The departures, if any, from the 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, and
   e. Exposure assumptions.

Pre-Visit Letter

39. S-6, Disclosure 1, page 237 – Provide the substantive research on return period wind speed estimates by landfall location used here.

40. Form S-4, Part B.B, page 248 – Verify $4.06 Billion value for Produced by Model.

Verified: YES

Professional Team Comments:

Reviewed results provided in Form S-4. A corrected Form S-4 with a modeled AAL of $4.03 billion will be provided in the revised submission.

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

Reviewed revised results in Form S-4.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

A. The modeler shall maintain a primary document binder, containing a complete set of documents specifying the model structure, detailed software description, and functionality. Development of each section shall be indicative of accepted software engineering practices.

B. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the modeler's submission shall be consistently documented and dated.

C. Documentation shall be created separately from the source code.

Audit

1. The primary document binder, in either electronic or physical form, and its maintenance process will be reviewed. The binder shall contain fully documented sections for each Computer Standard.

2. All documentation shall be easily accessible from a central location.

3. Complete user documentation, including all recent updates, will be reviewed.

4. Modeler personnel, or their designated proxies, responsible for each aspect of the software (i.e., user interface, quality assurance, engineering, actuarial, 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 the source code.

6. A table for each item listed in Standard G-1, Disclosures 5 and 6 will be reviewed. The table 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, Disclosures 5 and 6 through all Computer Standards.

Information to be presented to the Professional Team:

- C-1.A, B & C, page 249 – EQECAT maintains all such documentation, and will have it available to the professional team during the on-site visit.

Verified: YES

Professional Team Comments:

Reviewed the Primary Document Binder and the master list of reference documents dated December 1997 – April 2008.

Observed initially inconsistent date updating of model documentation.

Reviewed the following documentation and their updates:

- Land Use and Land Cover Update
- Storm and Milepost Based CatIndex
- Inland Decay Methodology Specification
- Profile Factor Specification
- Requirements for 2007 Update

Reviewed the table indexed by each item listed in Standard G-1, Disclosure 5.

Reviewed new documentation revised by last date modified and a modification history.

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

Reviewed Mobile Home Vulnerability Update documentation.

C-2 Requirements

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

Audit

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.

Information to be presented to the Professional Team:

- C-2, page 250 – EQECAT maintains such requirements and documentation, and will have it available to the professional team during the on-site visit.
- C-2.1, page 250 – EQECAT maintains a set of documents describing the specifications and produce requirements for user interfaces, database schema, client customizations, security considerations, user manuals, and references. The above documentation will be available to the professional team during the on-site visit.

Verified: YES

Professional Team Comments:

Reviewed the "Requirements for 2007 Update" document containing requirements corresponding to items in Standard G-1, Disclosure 5.

C-3 Model Architecture and Component Design

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

Audit

1. The following will be reviewed:

   a. Detailed control and data flow diagrams, completely and sufficiently labeled for each component,
   b. Interface specifications for all components in the model,
   c. Documentation for schemas for all data files, along with field type definitions,
   d. Each network diagram including components, sub-component diagrams, arcs, and labels.

2. A model component custodian, or designated proxy, shall be available for the review of each component.

Information to be presented to the Professional Team:

- C-3, page 251 – The design levels of the software have been documented, including software components and interfaces, data files, and database elements. This documentation will be shown to the professional team during the on-site visit.

Verified: YES

Professional Team Comments:

Reviewed land use land cover (LULC) class hierarchy diagrams.

Reviewed the following flowcharts:
Profile Factor Calculation
Inland Decay Calculation
ZIP Code Processing
Filling Rate Calculation

C-4 Implementation

A. The modeler shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.

B. The modeler shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.

C. All components shall be traceable, through explicit component identification in the flow diagrams, down to the code level.

D. The modeler shall maintain a table of all software components affecting loss costs, with the following table columns: (1) Component name, (2) Number of lines of code, minus blank and comment lines; and (3) Number of 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 modeler shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosures 5 and 6:

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, and
    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.

Information to be presented to the Professional Team:

- C-4.D, page 252 – This table will be available for review by the professional team.
- C-4.E, page 252 – The underlying model including algorithm implementation and technical assumptions along with the procedures used for updating the system data will be available for review by the professional team during the on-site visit.
- C-4.E, page 252 – System documentation is maintained to define critical system functionality in terms of Data Flow Diagrams, Structure Charts, and the corresponding narratives which describe how each module functions. This information is available for on-site review.
- C-4.F, page 253 – This list will be available for review by the professional team.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Reason for non-verification: Unable to verify pending verification of Standards M-4, V-1, and A-4.

Reviewed the equation-variable cross-list documentation for the following:
Inland Decay Rate Calculation
Profile Factor Calculation
Storm and Milepost Based CatIndex

Reviewed the land use land cover point-in-polygon algorithm.

Reviewed the land use land cover conversion code.

Reviewed the inland decay rate implementation.

Reviewed the implementation of the exponential decay rate function referenced on page 59 of the submission.

Reviewed the software component comments table specified in Standard C-4.D.

Reviewed implementation of code used to produce Form V-1.

Reviewed the revised land use friction factors used to create a color-coded map by ZIP Code.

Reviewed the algorithm and implementation for smoothing data for distribution of profile factor by landfall location.

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

Reviewed original Fortran code used for implementing a simulation for calculating and validating demand surge.

Reviewed revised Fortran code containing:

- Software components required by Standard C-4.D
- More explanatory comments
- Meaningful variable names
- List of variables cross-referenced with Excel cell identifiers and descriptions

Reviewed Excel spreadsheet calculations paralleling the Fortran code results.

Reviewed the C++ code implementing the quality factor used for mobile homes.

Reviewed the C++ code to modify the damage curve based on the quality factor.

C-5 Verification

A. General

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

B. Component Testing

1. The modeler shall use testing software to assist in documenting and analyzing all components.

2. Unit tests shall be performed and documented for each component.

3. Regression tests shall be performed and documented on incremental builds.

4. Aggregation tests shall be performed and documented to ensure the correctness of all model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

C. Data Testing

1. The modeler shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.

2. The modeler shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.

Audit

1. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.

2. The testing software used by the modeler will be reviewed.

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.

Pre-Visit Letter

41. C-5.A, page 255 – Provide a statement to the effect that verification tests have been performed by modeler personnel other than the original component developers *for each* component.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Reason for non-verification: Unable to verify pending verification of Standards M-4, V-1, and A-4.

Verified that tests were performed by modeler personnel other than the original component developers.

Reviewed the testing approach and results relating to the model and data changes itemized on Standard G-1, Disclosure 5.

Reviewed patch testing process associated with the new land use land cover database.

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

Reviewed face validation and statistical tests to address code and data changes made by the modeler to the following:

- Profile factor calculation
- Vulnerability curve for tied-down mobile homes
- Demand surge calculations incorporating more recent storms

C-6 Model Maintenance and Revision

A. The modeler shall maintain a clearly written policy for model revision, including verification and validation of revised components, databases, and data files.

B. A revision to any portion of the model that results in a change in any Florida residential hurricane loss cost shall result in a new model version number.

C. The modeler shall use tracking software to identify all errors, as well as modifications to code, data, and documentation.

Audit

1. All policies and procedures used to maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, the modeler shall 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.

Information to be presented to the Professional Team:

- C-6.C, page 257 – EQECAT's policies and procedures for model revision will be made available to the professional team during the on-site visit.
- C-6.1, page 257 – EQECAT has a series of ISO procedures regarding the maintenance of code, data, and documentation, and these will be made available to the professional team.

Verified: YES

Professional Team Comments:

Reviewed Software Build Process flowchart.

Reviewed the policy for model revision.

Reviewed the approach used for model version numbering.

C-7 Security

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

Audit

1. The written policy for all procedures and methods used to ensure the security of code, data, and documentation will be reviewed. Specify all security procedures.

2. Documented security procedures for access, client model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

Information to be presented to the Professional Team:

- C-7, page 258 – These procedures will be made available to the professional team during the on-site visit.

Verified: YES

Professional Team Comments:

Verified no change to security procedures from the prior year's submission.