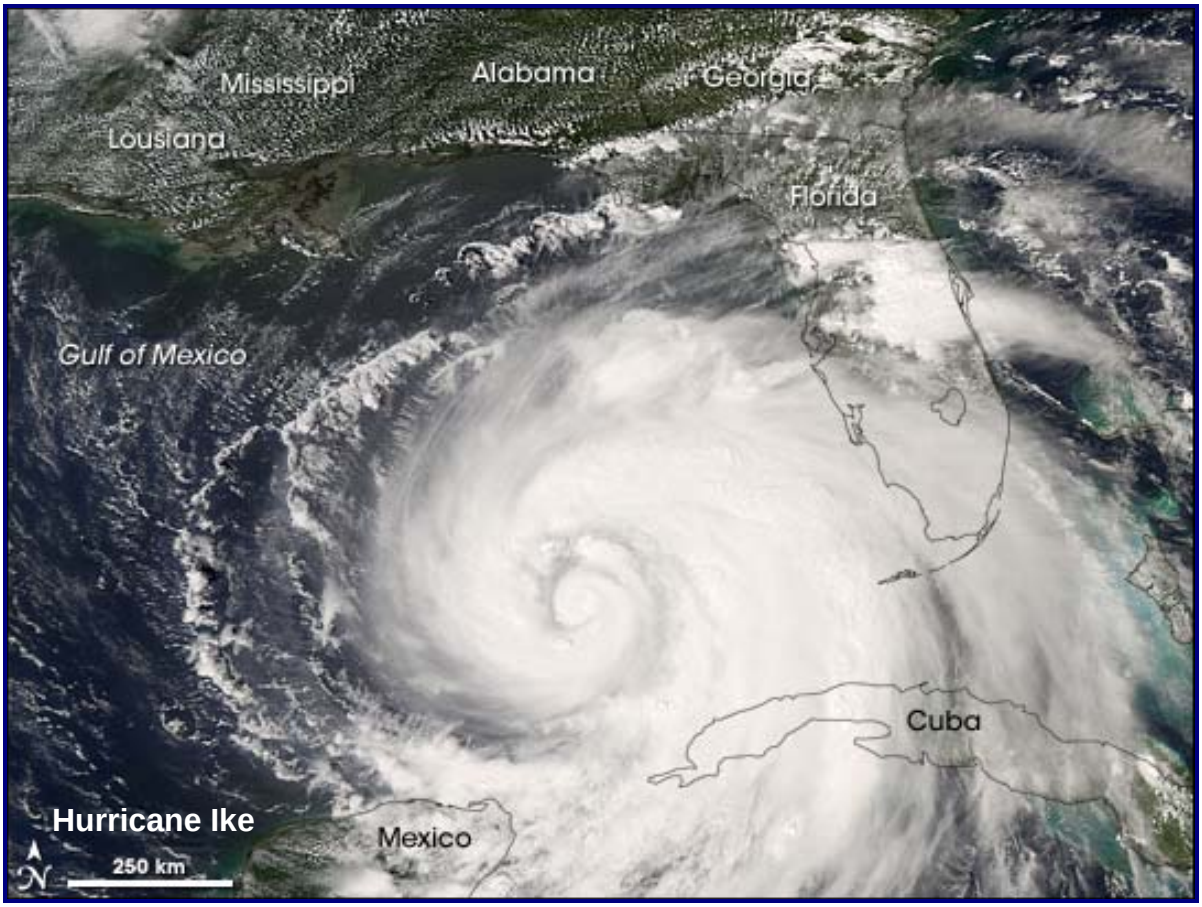
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2008 Standards

EQECAT, Inc.

On-Site Review
April 13 – 15, 2009

Additional Verification Review
June 2, 2009

On April 13-15, 2009 the Professional Team visited on-site at EQECAT, Inc. 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., Project Engineer
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., Director (Structural Engineering)
Bob Konz, Structural Wind Engineer (via phone)
John Mangano, Vice President, Meteorologist
David F. Smith, Senior Vice President, Technology Development and Consulting
Jie Zhou, 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 began with a discussion of the following model change:

- Probabilistic hurricane database regenerated to be consistent with HURDAT as of June 1, 2008, and to additionally include the 2008 hurricane season.

During the course of the audit, a further change was identified relative to a sampling method (see revised response to G-1.5).

The Professional Team was unable to verify Standards A-6 (Logical Relationship to Risk) and A-10 (Output Ranges). Consequently, Standards G-1, G-4, G-5, C-4, and C-5 could not be verified as they require the verification of all other standards. At the exit interview, modeler options as given in the Report of Activities were reviewed.

The Professional Team reviewed EQECAT's responses to the deficiencies noted at the March 19, 2009, Commission meeting. EQECAT provided updated Expert Certification Forms G-1, G-3, G-4, G-5, and G-7 in response to the deficiencies.

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 May 19-21, 2009 meetings:

- Page 20, G-1.3, Figure 3 flowchart "users" clarified
- Page 22, G-1.4, secondary structural modifiers reference added to vulnerability references
- Page 23, G-1.5, annual frequency sampling method change added

- Page 46, M-2.1, landfall location wording updated
- Page 46, M-2.1, track direction wording updated
- Pages 47-48, M-2.1, profile factor wording updated
- Page 48, M-2.2, revised to include Rmax as a function of landfall location
- Page 50, M-2.8, hurricane track data updated
- Page 52, M-3.2, revised to include data sources
- Page 55, M-4.6, revised to more accurately reflect the date of the land use and land cover data
- Page 60, M-5.2, Figures 6b and 6c revised, figure numbering also corrected
- Pages 69-71, Form M-2 revised
- Pages 72-73, Form M-3 revised
- Page 74, V-1.A, Hurricane Ike (2008) added to post-disaster field surveys
- Page 77, V-1.3, secondary structural modifiers reference updated and recent site inspections added
- Page 89, A-1, response revised to include probable maximum loss
- Page 91, A-2.4, response revised for clarification
- Page 121, A-10.2, annual frequency sampling method change added
- Pages 210-213, Form A-8 revised
- Page 219, S-1.3, Table 3 revised
- Page 235, Form S-3, rationale revised
- Pages 236-237, Form S-4, blank tables removed
- Page 252, C-6.2, revised to include addition to G-1.1 from deficiency response
- Figure numbering revised throughout submission to use whole numbers only

Additional Verification Review – June 2, 2009

EQECAT submitted revised Forms A-3, A-4, A-5, A-6, A-7, A-8, A-9, S-2, and S-5 on May 18, 2009. Forms A-6, A-7, and A-8 were regenerated in accordance with the Form A-6 instructions contained in the Report of Activities. The Professional Team met with EQECAT on June 2, 2009 in Tallahassee to review the revisions submitted.

The following individuals participated in the additional verification review:

EQECAT
Justin Brolley, Ph.D., Hazards Modeler and Research Scientist
Apoorv Dabral, Ph.D., Project Engineer
Aarti Dinesh, Product Manager
Omar Khemici, Ph.D., P.E., Director (Structural Engineering)
John Mangano, Vice President, Meteorologist
David F. Smith, Senior Vice President, Technology Development and Consulting

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

EQECAT provided an explanation of the change in the calculation of the weighted quality factors for the exposure data as the basis for completion of Form A-6, Output Ranges. Other forms were revised for consistency with the completion of Form A-6. 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 March 19, 2009 meeting. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Standard G-1 (page 10)
   In response to standard, no mention of probable maximum loss as part of the scope

2. Standard G-1, Disclosure 1 (page 10) and Model Identification (page 5)
   No version number provided

3. Standard G-1, Disclosure 2 (page 10)
   Summary provided is not comprehensive, as required. For example, referenced publications listed on pages 20-22 are not incorporated in the text.

4. Standard G-1, Disclosure 5 (page 23)
   Effect of the change on personal lines residential loss costs not provided

5. Standard V-1 (page 74)
   In the third paragraph under part A, the language indicates an additional update to the mobile home vulnerability functions from those that were initiated previously. If so, the update should be included in Standard G-1, Disclosure 5. If not, this language should more clearly reflect the current submission.

6. Form A-9 (page 217)
   No uncertainty intervals provided

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. The goal is to identify lines of inquiry to be followed during the on-site review so as to allow adequate advance preparation by the modeler. Aside from due diligence with respect to the full submission, various requests for information and 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 the upcoming conference call that will be held, if requested by the modeler. One goal of the potential conference call is to clarify points in this letter. The comments are grouped by Standards sections. 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.

The items provided below are to assist the modeler in preparing for the on-site review. Some of this material may have been shown or been available on a previous visit by the Professional Team. The Professional Team will also be considering material in response to the Commission's designation(s) of deficiencies and issues.

The goal of the Professional Team on-site review is to provide the Florida Commission on Hurricane Loss Projection Methodology (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 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 an internet connection through one of the Professional Team member computers for reference work that may be required while on-site.

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 engineering data (post event surveys, tests, etc.) received since 2005. Describe any processes used to amend or validate the model that incorporates this engineering data. Describe any processes used to amend or validate the model that incorporates insurance company claims data covering the 2004 and 2005 hurricane seasons, especially processes used since the prior visit by the Professional Team.

Provide and describe all studies performed to determine whether the model meets the "probable maximum loss" requirements added to the standards in the 2008 Report of Activities (Standard A-11 and several other standards and forms).

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.

Demonstrate that output reports produced by a user of the model reveal the values of all user inputs and selections used to run the model.

When the Professional Team arrives on-site, 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.

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

ISSUES:

Describe how the model incorporates number of stories in the vulnerability functions.

Discuss the development and application of mitigation credits for various parts of the state, by region (North, Central and South), and by proximity to water (Coastal and Inland) as defined in Form A-7. Expansion to structure types that resemble the actual Florida building stock is desired.

TRADE SECRET MATERIAL:

Describe how the model determines the magnitude of demand surge to include in the calculation of loss costs and probable maximum loss levels.

Show the Professional Team "supportive design diagrams, equations, and pseudo-code" that you intend to show the Commission during the closed meeting portion of the modeler presentation.

GENERAL STANDARDS – Mark Johnson, Leader

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

*(*Significant Revision)*

The computer model shall project loss costs and probable maximum loss levels for personal lines residential property insured damage 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 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. 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 and probable maximum loss levels (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.

Verified: YES

Professional Team Comments:

Reviewed the update to the probabilistic hurricane database to include HURDAT as of June 1, 2008, and to include the 2008 hurricane season.

Reviewed the new annual frequency sampling method. Response to Disclosure 5 revised to include this change in the model.

Reviewed the revision to the *comprehensive* summary in response to this deficiency.

Verified with the modeler that EQECAT Florida Hurricane Model 2009 is a subset of WORLDCATenterprise/USWIND.

G-2 Qualifications of Modeler Personnel and Consultants*

*(*Significant Revision)*

A. Model construction, testing, and evaluation shall be performed by modeler 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 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

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

1. G-2, Disclosure 2.B, page 29: Provide the resumes of the three new employees (Alexander Volkov, John Mangano, and Annes Haseemkunju).

2. G-2, Disclosure 3.A, pages 30-31: Document how the reviews listed pertain to components as currently functioning in the model.

Verified: ~~**CONTINGENT UPON RECEIPT OF COMPLETED EXPERT CERTIFICATION FORMS**~~
YES

Professional Team Comments:

Completed Expert Certification Forms G-1, G-4, G-6, and G-7 are required for verification.

Reviewed resumes of personnel new to this year's model:

- Annes V. Haseemkunju, B.S., Physics, Mahatma Gandhi University, Kottayam, India; M.S., Meteorology, Cochin University of Science and Technology, Cochin, India; Ph.D., Meteorology, Cochin University of Science and Technology, Cochin, India
- John J. Mangano, B.S., Physics and Astronomy, University of Virginia; M.S. Meteorology, Rutgers University
- Alexander Volkov, B.S., Economics, Moscow University of Consumer Cooperation, Moscow, Russia; M.S., Software Engineering, International Technological University, Sunnyvale, California

Discussed with Bob Konz his qualifications and affiliation with EQECAT involving the Vulnerability Standards.

Discussed the relevance of the 1996 peer review provided in the submission to the components currently functioning in the model.

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

Reviewed updated Expert Certification Forms.

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.

3. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.

Verified: YES

Professional Team Comments:

Verified no change in the ZIP Code centroid database from the previous submission.

Reviewed maps of ZIP Code centroid locations. Verified no ZIP Code centroids exists over water.

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**
~~**Unable to verify pending verification of Standards A-6 and A-10**~~

Professional Team Comments:

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

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

G-5 Editorial Compliance*

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

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.

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, 2008*.

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 inclusion of extraneous data or materials.

4. The modification history for submission documentation will be reviewed.

5. A flowchart defining the process for Form creation will be reviewed.

6. Form G-7 will be reviewed.

Pre-Visit Letter

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

3. G-5, Audit item 5 from page 73 of Report of Activities: Provide the flowchart used for Form creation.

Verified: ~~**NO**~~ **YES**
~~**Unable to verify pending verification of Standards A-6 and A-10**~~

Professional Team Comments:

Reviewed flowcharts describing submission form creation.

Discussed with David Smith his process for editorial review and the involvement of other EQECAT personnel in reviewing forms submitted.

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*****

Reviewed updated Editorial Certification Form G-7.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in the model and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 1, 2008 (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. 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. Form M-1 will be reviewed for consistency with Form S-1.

6. 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

4. Form M-1, page 65: Discuss the methodology used to produce the table, especially the "entire state" statistics.

5. Form M-1, page 65: Discuss the changes in modeled storm counts from the previous submission.

Verified: YES

Professional Team Comments:

Reviewed the storm set updated to HURDAT starting at 1900 as of June 1, 2008, with the 2008 hurricane season also included. Hurricane Dolly (2008), Hurricane Gustav (2008), and Hurricane Ike (2008) were included in the storm set with the use of National Hurricane Center advisory data. Discussed no impact on the model for Florida storms from the inclusion of the 2008 hurricane season storms.

Reviewed the storms that changed due to the update of the HURDAT dataset. Reviewed map of storm tracks for the storms that changed from last year. Discussed the two storms that changed in HURDAT yet were not updated in the modeler's base hurricane storm set.

Reviewed supporting information for the 1916 storm in support of Category 1 winds over Florida. Review included observations, considerations of observation quality (3 versus 4 cup anemometers, units conversion issues), and Monthly Weather Review articles.

Reviewed the modeler stochastic storm database to confirm that a set of Category 4 storms making landfall in the Keys also result in Category 2 winds over southeast Florida for reasonable values of Rmax and profile factor.

Discussed that for next year's submission the modeler plans to incorporate the complete, revised HURDAT valid June 1, 2009, for determining landfall frequencies in the model.

Discussed the modeler's process in updating their base hurricane storm set.

Verified no trending, weighting, or partitioning was performed with respect to the Base Hurricane Storm Set.

Discussed the methodology used to produce the table in Form M-1. Reviewed a revised Form M-1 with "Entire State" counts corrected for multiple landfalls.

Discussed and resolved the discrepancies between Form M-1 and Form S-1. Verified that Forms M-1 and S-1 are consistent.

Reviewed goodness-of-fit results of modeled to historical hurricane frequencies by region, statewide, by-passing, and adjacent states using Pearson Chi-Squared Test.

Examined historical documents on storms from 1995 and earlier.

Discussed the modeler's revision to the code used for annual frequency sampling and the resulting improved accuracy.

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, strike probabilities, 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:
   - 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

6. M-2, Disclosure 1, page 46: Discuss the use of the 1900-1998 time period for the track direction distribution.

7. M-2, Disclosure 1, page 47: Justify the maximum windspeed of 180 mph compared to 185 mph noted on page 68.

8. M-2, Disclosure 1, pages 47-48: Document the underlying data used to derive the profile factor distribution.

9. M-2, Disclosure 2, page 48: Discuss the variation of Rmax "as a function of landfall only."

10. M-2, Disclosure 2, page 48: Discuss the lower bound, if any, on profile factor.

Verified: YES

Professional Team Comments:

Reviewed the hurricane parameters used in the model.

Discussed the track direction distributions. Response to Disclosure 1 revised to indicate storm direction varies geographically, and the track direction distributions are based on smoothed historical data. The historical data used was the set of all hurricanes in HURDAT from 1900-2001 as of June 1, 2003.

Discussed the change in maximum windspeeds from the previous submission not being reflected in the contour maps provided in Form M-2. Discussed the incorrect deduction of maximum windspeeds in the previous submission.

Discussed the derivation of the profile factor distribution. Response to Disclosure 1 revised to indicate the use of Hurricane King (1950) and Hurricane Carla (1961) published wind patterns.

Discussed the variation of Rmax as a function of landfall location only except for storms more intense than 930mb. Response to Disclosure 2 revised for clarification.

Discussed the bounds imposed on the profile factor. Reviewed the range of profile factors for the historical database and the stochastic storm set.

Reviewed the dataset basis for the fitted distributions for landfall location, maximum sustained winds, radius of maximum winds, translational speed, filling rate, and profile factor.

Reviewed graphical comparison of the profile factor versus radius of maximum winds for a subset of historical storms.

Verified that the maximum 1-minute sustained 10-meter windspeeds, not the central pressure or the gradient windspeed, is used as input into the windfield model.

Reviewed the external data sources that affect model generated windfields.

Discussed the numerical value of the far-field pressure used in the model.

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 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.

Pre-Visit Letter

11. M-3, Disclosure 1, page 51: These publications do not go beyond 2004. Discuss data sources for the 2004 and 2005 storms.

12. M-3, Disclosure 2, page 52: Give specific sources for each data type, including specific storms or years used (as appropriate). The answer appears to be inconsistent with the response to Standard M-2. For example, the use of tropical cyclone preliminary reports and information needed for profile factor distributions are not encompassed by these sources.

Verified: YES

Professional Team Comments:

Reviewed the quality of fit of landfall frequencies for adjacent states.

Discussed the analysis of recent storms used for the profile factor. Responses to Disclosures 1 and 2 revised to provide data sources.

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 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 (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005).

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

13. M-4, Disclosure 1, page 53: Discuss the inertial stability of the radial windfield profile across the range of profile factor.

14. M-4, Disclosures 2 & 3, page 54: Justify the continued use of the NWS-23 windfield.

15. M-4, Disclosure 6, page 55: Be specific about the publication date of the land use and land cover dataset implemented in the model.

16. M-4, Disclosure 8, pages 55-56: Discuss the methodology used to produce Figure 6a and the results therein.

17. M-4, Disclosure 9, page 56: Provide windfield comparisons for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005), and justify their reasonableness.

18. Form M-2, pages 69-71: Discuss the methodology used to produce Figures 9 (a,b) and 10 (a-d) and the results therein.

19. Form M-2, pages 70-71: Identify the locations of the maximum winds in each panel of Figure 10.

Verified: YES

Professional Team Comments:

Reviewed revised Form M-2 for the location and values of the maximum windspeeds. Discussed the process used to produce and verify the maps. Reviewed flowchart for creation of the revised Form M-2 to ensure diagnosis of correct maximum windspeeds.

Discussed the inertial stability of radial windfield profile across the range of profile factors. Reviewed two alternative references for computation of inertial stability. Discussed equivalence of results obtained using the two methods. Reviewed flowchart of validation process. Reviewed code for computing angular momentum and inertial stability. Reviewed that the range of profile factors used exceeds the minimum value required for an inertially stable vortex.

Discussed the use of the NWS-23 windfield for storm profile, the asymmetry term, and frictional transition.

Reviewed the generalized standard profile equation for storm radial wind profile and profile factor. Reviewed the average absolute error in knots for the 24 cases in the NWS-23 Table 13.1.

Reviewed graphical comparisons of the modeled wind radial profile to the Holland B wind profile for Hurricane Donna (1960), Florida Keys storm (1935), and Hurricane Carla (1961).

Reviewed graphical comparisons of the modeled wind radial profile to the Willoughby wind profile for Hurricane Anita (1977), Hurricane Mitch (1998), and Hurricane Hugo (1989).

Reviewed contours of the windfield structure with asymmetry term.

Reviewed the methodology developed for frictional transition, onshore winds to overland. Reviewed the equations used for transitioning between overwater onshore windspeeds to a frictionally reduced overland windspeed.

Reviewed the land use and land cover data set implemented in the model.

Reviewed the methodology for producing the windfield for Hurricane Wilma (2005) depicted in Figure 6a on page 56. The figure has been renumbered.

Reviewed windfield comparisons of Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005). Reviewed scatter plots of observed data to modeled data,

residual QQ-plots of theoretical quantiles to sample quantiles, empirical cumulative probability plots of windspeeds difference to cumulative probability, and box plots of location to windspeeds.

Reviewed the method for assignment of modeled windspeed uncertainty in comparisons with observed winds.

Reviewed the sources for relativities among the modeled wind locations.

Verified no change in the methodology for assigning roughness coefficients for Florida and adjacent states.

Reviewed the spatial distribution of surface roughness used in the model. Discussed the use of distributions on surface roughness and gust factor for the stochastic storm set, where the mean of the distribution corresponded to the deterministic values.

Discussed other variables in the model that affect over-land surface windspeed estimation.

Reviewed Table 3 (Standard S-1, page 219) for windfield validation. Discussed that the results reported in the original submission are not available in tabular form. Reviewed the data and process used to extend these analyses. Reviewed a revised Table 3, included in the submission.

M-5 Landfall and Over-Land Weakening Methodologies

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

20. M-5, Disclosure 2, pages 60-61: Discuss the application of the rapid decay zone after landfall and its representation in Figures 6b and 6c.

Verified: YES

Professional Team Comments:

Discussed the modeled windspeeds and degradation rates used to generate Figures 6b and 6c. Reviewed the revised figures using the correct windspeeds.

Reviewed graphical representations of the filling rate parameter for the Florida peninsula and the Gulf coast comparing central pressure at landfall to the exponential decay parameter.

Reviewed the quadratic equation for the transition of winds from over-water to over-land.

Reviewed maps of windspeed reduction across Florida for a standard onshore wind value at all coastal points.

Reviewed the revised Form M-2. Discussed the change from the previous submission differences between open and actual terrain maximum windspeeds and the new differences.

Determined that the changed modeled intensity over land for the 1916 storm and Hurricane Frances (2004) (pages 60 and 61) in the revised pages derive from 1) treatment of observations as actual exposure, 2) application of the initial filling zone at landfall, and 3) deduction of the consequent filling rate implied from the observations.

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.

Pre-Visit Letter

21. Form M-3, page 73: Discuss the changes in Figure 11 from the previous submission. Justify the upper bound for Rmax.

Verified: YES

Professional Team Comments:

Reviewed revised Form M-3.

Reviewed a graphical comparison of storm asymmetry for a set of hypothetical modeled hurricanes moving with different speeds.

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, and 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. 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).

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. The effects on building vulnerability from local construction characteristics and building codes will be reviewed.

8. Form V-1 will be reviewed.

Pre-Visit Letter

22. V-1.A, page 74: Describe the process and the data collected to validate the wood frame and masonry vulnerability functions, with specific reference to 2004 and 2005 data.

23. V-1.E, page 75: Florida Building Code (2001) and South Florida Building Code (1994) are listed in the List of References on pages 20-22; however, these are not actually referenced in the submission responses, including in the response provided here. Document the application of these references.

24. V-1, Disclosure 3, page 77: Describe any site inspections made for the 2004 and 2005 major storms. The submission refers to earlier work (July 2003).

From preamble: Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since 2005. Describe any processes used to amend or validate the model that incorporates this engineering data. Describe any processes used to amend or validate the model that incorporates insurance company claims data covering the 2004 and 2005 hurricane seasons, especially processes used since the prior visit by the Professional Team.

25. V-1, Disclosure 6, page 79 (new this year): Describe the process of examining the building code revisions and enforcement and their impact on the vulnerability model, including Florida Building Code Revisions 2001, 2004, and their supplements/amendments.

ISSUE:
Describe how the model incorporates number of stories in the vulnerability functions.

Verified: YES

Professional Team Comments:

Discussed the process for analyzing loss data. Reviewed flowchart for reviewing and analyzing loss data.

Discussed the recent loss data analyzed from Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005).

Discussed post-disaster field surveys conducted for several storms in the past few years.

Discussed the breakdown of the loss data received from individual insurance companies by coverage types.

Reviewed the 2004 and 2005 claims data statistics including the number of policies, number of claims, and the total insurance value for masonry, wood frame, and mobile homes.

Reviewed sensitivity test results used for validation of the existing vulnerability functions, one for wood frame and one for unreinforced masonry.

Reviewed scatter plots by ZIP Code of aggregated unreinforced masonry and wood frame losses from the 2004 and 2005 loss data from one insurance company.

Reviewed box plot of unreinforced masonry loss data compared to the residential, low-rise, unreinforced masonry, average cladding vulnerability function.

Reviewed a normalized residual plot of the observed mean to the vulnerability function mean for the unreinforced masonry building.

Reviewed goodness-of-fit results for a Shapiro test on the normalized residuals.
Reviewed box plot of wood frame loss data compared to the residential, low-rise, wood frame, average cladding vulnerability function.

Reviewed a normalized residual plot of the observed mean to the vulnerability function mean for a wood frame building.

Discussed how the model incorporates number of stories in the vulnerability functions.

Discussed building code enforcement not used as a secondary structural modifier. Reviewed the age groups for mobile homes and other structures.

Discussed site inspections conducted following Hurricane Charley (2004), Hurricane Jeanne (2004), Hurricane Ivan (2004), Hurricane Frances (2004), and Hurricane Katrina (2005).

Reviewed Hurricane Charley (2004) field report.

Discussed the application of the Florida Building Code, the review of building code revisions and their enforcement. The base vulnerability function does not reflect regional variations in the 2001 Florida Building Code. Year built can be addressed by the model. The impact of a building code change is evaluated to assess the extent of credit to be allocated in the secondary structural modifiers module. The secondary modifiers are used to capture construction characteristics and building codes. The secondary structural modifiers include the 2001 Florida Building Code.

Reviewed the building vulnerability functions for average cladding. Discussed the differences in the reinforced and unreinforced masonry vulnerability functions. Discussed the 2004 and 2005 claims data being classified as unreinforced masonry only.

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 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

When the Professional Team arrives on-site, 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.

ISSUE:
Discuss the development and application of mitigation credits for various parts of the state, by region (North, Central and South), and by proximity to water (Coastal and Inland) as defined in Form A-7. Expansion to structure types that resemble the actual Florida building stock is desired.

Verified: YES

Professional Team Comments:

Reviewed Form V-3 and confirmed consistency with the submitted Form V-2.

Discussed the development of the mitigation features for metal roof.
Discussed with Bob Konz the performance of metal roof covering in residential buildings and comparison with the performance of shingles. Further discussed the performance of metal roof covering in wood frame and masonry residential buildings and descriptions of performance of metal roof and wood shingles in the following reference.

Documentation reviewed:

- Secondary Structural Modifiers: Features and Model Description, Revision 1, 2008

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs and Probable Maximum Loss Levels*

*(*Significant Revision)*

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.

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 definition of an event including handling of by-passing storms.

A-2 Underwriting Assumptions*

*(*Significant Revision)*

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 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) 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" or claim practices of insurers with respect to concurrent causation.

Pre-Visit Letter

26. A-2, Disclosure 4, page 91: Provide data, backup and a detailed description of the referenced studies and analyses.

Verified: YES

Professional Team Comments:

Reviewed 2004 and 2005 loss data processed and analyzed for validation of the wood frame and unreinforced masonry vulnerability functions. Discussed the assumptions made regarding reinforced versus unreinforced masonry and frame versus veneer.

Reviewed the insurance company cause codes accompanying the claims data. Reviewed the coding for appurtenant structures.

Reviewed exposure and loss data from Hurricane Alicia (1983).

A-3 Loss Cost Projections and Probable Maximum Loss Levels*

*(*Significant Revision)*

A. Loss cost projections and probable maximum loss levels 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 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.

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

A-4 Demand Surge*

*(*Significant Revision)*

A. Demand surge shall be included in the model's calculation of loss costs and probable maximum loss levels 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 incorporate individual aspects of demand surge on each coverage type, inclusive of the effects from building material costs, labor costs, contents costs, repair time, etc.

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

Pre-Visit Letter

TRADE SECRET MATERIAL: Describe how the model determines the magnitude of demand surge to include in the calculation of loss costs and probable maximum loss levels.

Verified: YES

Professional Team Comments:

Verified no change in the methodology for demand surge calculations from the previous year. Discussed no additional studies have been conducted.

Discussed demand surge effects on coverages A, B, C, and D.

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.

Pre-Visit Letter

Demonstrate that output reports produced by a user of the model reveal the values of all user inputs and selections used to run the model.

Verified: YES

Professional Team Comments:

Discussed the process of analyzing and verifying the accuracy of insurance claims data.

Verified that the model output reports will include all of the model version numbers for the Florida Hurricane Model, the standalone software USWIND, and the client-server software WORLDCATenterprise used to produce the output.

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

Verified the quality factors selected as input are disclosed on the model output report.

A-6 Logical Relationship to Risk*

*(*Significant Revision due to new Form)*

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

27. Form A-5, page 163: Explain the damage due to Hurricane Ivan (2004) well outside the panhandle area.

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

Professional Team Comments:

Form A-6 was completed without consideration of regional differences in the application of the 2001 Florida Building Code.

Discussed the damage distribution for Hurricane Ivan (2005). Reviewed the windfield map for Hurricane Ivan (2005). Reviewed the track of Hurricane Ivan (2005) and the times of the observations used.

Reviewed maps of loss costs by ZIP Code and county.

Reviewed maps on the effects of land friction on loss costs by ZIP Code.

Reviewed maps of loss costs provided in Forms A-4 and A-5.

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

Reviewed map of the State of Florida wind-borne debris region classifications for the 2001 Florida Building Code.

Reviewed table classifying secondary modifiers as they relate to the 2001 Florida Building Code by non-wind-borne debris region, wind-borne debris region, and high velocity hurricane zone (Miami-Dade and Broward Counties).

Reviewed methodology for calculating total insured value weighted average quality factors for each ZIP Code, structure type, and type of business.

Reviewed revised Forms A-3, A-4, and A-5.

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.

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. 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.

Verified: YES

Professional Team Comments:

Verified no change in the process for calculating and applying deductibles and policy limits. Deductible calculations are in compliance with s. 627.701(5)(a), F.S.

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 the process and calculations used to develop contents loss costs.

Reviewed the relationship between building and contents losses provided in the figure on page 117 of the original submission. Reviewed the potential outliers and their explanation.

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 (1992);
    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 the process and calculations used to develop ALE loss costs.

Discussed the effects of demand surge on ALE from Hurricane Andrew (1992).

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-6, A-7, and A-8 will be reviewed.

2. The modeler will be required to justify all changes from the prior submission using the 2007 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.

Pre-Visit Letter

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.

28. Form A-7, page 209: Provide an explanation for the probable cause of the output range changes such as $0 Deductible Frame North and $0 Deductible Frame South.

29. Form A-8, pages 210-211: Explain the preponderance of increases in the panhandle given that only the storm set was updated.

30. Form A-8, page 211: Explain the possible anomaly relating to the change in masonry loss costs shown for Desoto and its contiguous counties.

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

Professional Team Comments:

Discovered that Form A-6 was not properly completed using the FHCF exposure data provided. Year of construction and quality of building code information in hlpm2007.exe were not considered for this form. Determined that regional variations of building code were not explicitly captured by the model within Florida. A re-run of the output ranges is necessitated.

Discussed with Shawna Ackerman her review and understanding of the changes in loss costs as a result of the update to the model as provided in the initial February 2009 submission.

Discussed the changes in loss costs from the previous year's submission for several categories and geographic areas. Increases in loss costs were attributed to the updates to the base storm set and the decreases in loss costs were attributed to the update of the frequency methodology.

Reviewed the change in masonry loss costs for Desoto and surrounding counties.

Discussed the area pattern for loss costs in Duval and adjacent counties in Form A-8. Reviewed the new method for annual frequency sampling.

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

Reviewed the method for calculating the loss costs in Form A-6.

Reviewed incorporation of year built and the inclusion of the 2001 Florida Building Code in the modeled exposure data for Forms A-6, A-7, and A-8.

Reviewed percentage changes in Form A-6 from last year and from the initial 2009 submission.

Reviewed revised Form A-8 maps after inclusion of the 2001 Florida Building Code in the 2007 FHCF exposure data.

For purposes of this review, the modeler used a quality factor to incorporate regional variations in preparing the portfolio for completing Form A-6. The modeler will advise users of the need to use quality factors in preparing portfolios. The modeler agreed to incorporate the regional variations in the 2001 Florida Building Code explicitly in the next model submission.

A-11 Probable Maximum Loss*

*(*New Standard)*

The methods, data, and assumptions used in the estimation of probable maximum loss levels shall be actuarially sound.

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-9.

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

3. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedures used for calculating probable maximum loss levels.

Pre-Visit Letter

Provide and describe all studies performed to determine whether the model meets the "probable maximum loss" requirements added to the standards in the 2008 Report of Activities (Standard A-11 and several other standards and forms).

Verified: YES

Professional Team Comments:

Reviewed and discussed the methodology for producing probable maximum loss estimates.

Discussed review of probable maximum loss calculations with consulting actuary Shawna Ackerman.

Reviewed probable maximum loss calculation flowchart for a per occurrence loss.

Reviewed code for the probable maximum loss calculation.

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

Reviewed revised Form A-9.

STATISTICAL STANDARDS – Mark Johnson, Leader

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

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

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

Pre-Visit Letter

31. S-1, Disclosure 3, page 219: Provide examples of windspeed validations for each of the storms listed in Table 3.

32. S-1, Disclosure 5, page 220: Describe the impact of the profile factor on loss costs fixed by location compared to fully stochastic profile factors.

33. Form S-1, page 232: Justify the consistency for total number of storms between Form S-1 and Form M-1.

Verified: YES

Professional Team Comments:

Reviewed and resolved discrepancies in modeled frequencies between Form M-1 and Form S-1.

Reviewed rationale for the stochastic hurricane parameters provided in Form S-3. Form S-3 revised to reflect the rationale discussed.

Reviewed the validation and verification of modeled losses based on claims data from Hurricane Alicia (1983), Hurricane Elena (1985), Hurricane Gloria (1985), Hurricane Juan (1985), Hurricane Kate (1985), Hurricane Hugo (1989), Hurricane Bob (1991), Hurricane Andrew (1992), Hurricane Iniki (1992), Hurricane Erin (1995), Hurricane Opal (1995), Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004

(2004), Hurricane Jeanne (2004), Hurricane Katrina (2005), Hurricane Rita (2005), and Hurricane Wilma (2005).

Reviewed Friedman's original 1995 windspeed validation report to EQECAT. Reviewed validation comparisons of observed windspeeds with modeled windspeeds provided in Table 3 on page 219. Discussed the lack of tabular data from the original model windfield validation performed in 1995 and the creation of a new validation database. Based on the new validation data, Table 3 was revised.

Reviewed Kolmogorov-Smirnov test for the beta distribution on building damage relative to actual damages.

Reviewed windspeed validation maps and plots for Hurricane Donna (1960), Hurricane Betsy (1965), Hurricane Elena (1985).

Reviewed the impact of the profile factor on the loss costs fixed by location compared to fully stochastic profile factors.

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

Reviewed revised Form S-2.

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-6 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Verified no new sensitivity tests were performed since the previous year.

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-6 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Verified no new uncertainty tests were performed since the previous year.

Reviewed uncertainty analysis for frequency of storm on the full loss distribution for each event.

Reviewed uncertainty analysis on the estimation of loss from different independent sources of vulnerability functions.

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.

Verified: YES

Professional Team Comments:

Verified no change in the process of sample size determination nor the need to adjust the simulation sample size.

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:
      1. Personal versus commercial
      2. Residential structures
      3. Mobile homes
      4. Condominiums
      5. Structures only
      6. 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 validation comparisons provided in Form S-4.

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.

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

34. Form S-5, page 242: Explain why the Average Annual Zero Deductible Statewide Loss Costs does not agree with the Total Dollar Contribution provided in Form A-3 on page 130.

Verified: YES

Professional Team Comments:

Reviewed comparison of loss costs provided in Form A-3 and Form S-5.

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

Reviewed revised Form S-5.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation*

*(*Significant Revision)*

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

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

C. The modeler shall maintain (1) a table of all changes in the model from the prior year's submission to the initial submission this year and (2) a table of all substantive changes since this year's initial submission.

D. 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. 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.

Information to be presented to the Professional Team:

- C-1.A, B & D page 244 – EQECAT maintains all such documentation, and will have it available to the professional team during the on-site visit.

Pre-Visit Letter

35. C-1.C, page 244: Relate the table of contents with the response to Standard G-1, Disclosure 5 on page 23 by demonstrating individual table item compliance with the Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Reviewed the WORLDCATenterprise/USWIND primary document binder. Discussed how this documentation related to the Florida Hurricane Model 2009.

Reviewed the table of changes in the model from the previous year's submission.

Reviewed documentation for landfall smoothing technique.

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 245 – EQECAT maintains such requirements and documentation, and will have it available to the professional team during the on-site visit.
- C-2.1, page 245 – EQECAT maintains a set of documents describing the specifications and product 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 requirements for the 2008 model update to the probabilistic hurricane database.

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 246 – 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:

Verified no changes in the model architecture and component design.

Discussed the process for completing Form A-3.

Reviewed the flowchart for the per occurrence loss.

Reviewed flowchart procedure of adjusting the damage in the vulnerability curve for secondary structural modifiers.

Reviewed generation flowchart for the revised Form M-2.

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, 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, 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 247 – This table will be available for review by the professional team.
- C-4.E, page 247 – This 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. The [overall system design] information is available for on-site review.
- C-4.F, page 248 – This list will be available for review by the professional team.

Verified: ~~**NO**~~ **YES**
~~**Unable to verify pending verification of Standards A-6 and A-10**~~

Professional Team Comments:

Reviewed the residential, low rise, masonry, average cladding vulnerability function in the code.

Reviewed the C++ code used in the process of computing the values for Form A-3 from the FHCF exposure data.

Reviewed the data implementation for the loss data.

Reviewed the data implementation for the updated storm set.

Reviewed the automated process and code used to create Form A-3.

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

Reviewed the code for completing Form A-6.

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.

Verified: ~~**NO**~~ **YES**
~~**Unable to verify pending verification of Standards A-6 and A-10**~~

Professional Team Comments:

Verified no change in the testing methods from the previous submission.

Reviewed the testing methods for the import process into the EQECAT system to confirm accuracy of the data.

Reviewed the work instructions for product verification.

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

Reviewed maps and difference tables.

C-6 Model Maintenance and Revision*

*(*Significant 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.

D. The modeler 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, 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.

4. The list of all model revisions as specified in C-6.D will be reviewed.

Information to be presented to the Professional Team:

- C-6.C, page 251 – 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 251 – 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.

Pre-Visit Letter

36. C-6.D, page 251: Provide the model version history leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed the model version history. Verified no changes in the high-level policy or procedures for model revision.

Discussed the methodology for applying model version numbers to the Florida Hurricane Model 2009 and its relationship to the standalone software USWIND and the client-server software WORLDCATenterprise. Verified with the modeler that the most current version of USWIND and WORLDCATenterprise includes the latest Florida Hurricane Model version.

Reviewed a high-level flowchart defining the model revision policy for the software build process.

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 253 – These procedures will be made available to the professional team during the on-site visit.

Verified: YES

Professional Team Comments:

Verified no change to the security procedures from the previous submission.