Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2005 Standards

AIR Worldwide Corporation

On-Site Review
April 3-5, 2006

On April 3-5, 2006 the Professional Team visited on-site at AIR Worldwide Corporation (AIR) in Boston, Massachusetts. The following individuals participated in the review.

AIR

Justin A.W. Cox, Ph.D., Research Scientist/Meteorologist
Peter S. Dailey, Ph.D., Manager, Atmospheric Science
Glen Daraskevich, AVP, Research and Modeling
Boris Davidson, Chief Software Architect
John Ford, Senior Technical Writer
Jayanta Guin, Ph.D., Vice President, Research and Modeling
Hua He, Ph.D., Research Engineer
Vineet K. Jain, Ph.D., Research Engineer
David Lalonde, FCAS, FCIA, MAAA, Senior Vice President
Chris Lehner, Corporate Communications Specialist
Greta M. Ljung, Ph.D., Senior Research Statistician
Shangyao Nong, Ph.D., Senior Research Scientist, Meteorology
Miriam E. Perkins, ACAS, MAAA, Actuarial Analyst
John Rowe, Senior Research Engineer
Peter Sousounis, Ph.D., Senior Research Scientist/Meteorologist
Larry Trudeau, Software Engineering Manager

Professional Team

Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Fred Stolaski, P.E., Structural Engineer
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process. After a discussion of the Output Ranges deficiency, AIR gave a presentation highlighting refinements made in the 2006 model (Atlantic Tropical Cyclone Model V8.0) and their impact on statewide loss costs, as follows:

- Updated the ZIP Code database. Impact: +0.1%
- Updated the stochastic catalog for revisions made to the Rmax for intense hurricanes and the procedure for generating Florida by-passing storms. Impact: +6.4%
- Updated damage functions for low-rise apartment/condo wood frame and masonry buildings. Impact: +0.5%

Discussed and reviewed the following corrections to be made in the submission that will be provided to the Commission prior to the May 16-18, 2006 meetings.

1. Page 20, G-2.4, provide Powell 1996 reference in meteorological references.
2. Page 21, G-2.4, provide date for Savage reference.
3. Page 38, G-2.3B, revise to include peer reviews pertinent to the current Standards, Disclosures, or Forms.

4. Pages 44-48, Forms G-1 through G-5 with updated signatures after revisions made to the original February 28, 2006 submission.
5. Page 50, M-1.1, revised to include current NHC HURDAT reference for Ginny (1963).
6. Page 51 revised for correct Standard reference in the page header.
7. Page 52, M-2, response to Standard revised to remove the phrase "or on research conducted by AIR and accepted by the Commission."
8. Page 52, M-2.1, revised to include table of hurricane data for each hurricane characteristic and the period used from the HURDAT database.
9. Page 57, M-2.9, revised to include adjustments made to wind speeds once a storm has made landfall.
10. Page 62, M-4.2, revised to remove text after first sentence.
11. Page 67, M-5.5, revised to include additional comparisons for the modeled decay rate with observed winds.
12. Pages 72 & 73, Form M-2.C, revised to include the maximum winds simulated on each contour map.
13. Page 80, V-1.E, revised to remove *(*Significant Revision)* and to clarify assumptions made concerning building code enforcement.
14. Page 87, V-1.4, revised to include correct Figure reference, "(Figure 14)."
15. Page 93, Form V-1, revised to correct 41-50 mph wind speed range values.
16. Page 98, Form V-2, Table 6 revised to correct wind speed in title of last section.
17. Page 101, A-1, response to Standard revised.
18. Page 101, A-1.1, revised to clarify how damage from modeled storms is excluded or included in the calculation of loss costs.
19. Page 102, A-2.A, response to Standard revised.
20. Page 109, A-4.2, revised to remove incorrect Chapter reference in the CLASIC/2™ User's Guide.
21. Page 140, Form A-4, revised to correct misaligned numbers.
22. Page 195, S-1.3, revised to remove attribution to the Professional Team.
23. Page 214, Form S-1, revised to correct historical probabilities.
24. Page 217, Form S-3, revised to correct header in Comparison #4 for Coverage.

Reviewed and discussed additional information AIR anticipates including in their presentation to the Commission at the May model review meetings including the Trade Secret List information.

Report on Deficiencies

The Professional Team reviewed the following deficiency cited by the Commission at the March 16, 2006 meeting. The deficiency was corrected by the established time frame and the correction has been verified.

1. Form A-7, Output Ranges (pages 148-186)
   The printed Form has the county Miami-Dade whereas the electronic version has Dade County. Modeler did not provide output ranges in the format shown in the file named ***"2005FormA7.xls"*** as instructed in the *Report of Activities* on page 121.

   Revised electronic copy of Form A-7 submitted and verified.

Discussed in detail the process AIR uses in taking the output ranges produced by the model and inputting to the Commission format for submission purposes. Discussed steps taken to eliminate this problem from reoccurring and plans to implement changes to the computer code so that the model produces formatted results without having to process the data manually.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

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

2. Software located within the model, used to compile data used by the model, used to validate the model, and used to project model loss costs will be reviewed interactively.

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

Pre-Visit Letter

1. G-1, Disclosure 3, page 18 – Flowchart in Figure 3 does not show how Output Results are obtained from right hand portion of chart.

2. G-1, Disclosure 4, page 21 – Reference date for Savage et al. is missing.

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

Professional Team Comments:

Discussed how the Output Ranges fit into the flowchart process provided in Figure 3 on page 18.

Revised response to be provided to the Commission:

- G-2.4, pages 20 & 21, include (1) the Powell 1996 reference under the meteorological references and (2) the date for the Savage reference under the damage estimation references.

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Revised response to G-2.4 received and reviewed by the Professional Team.

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 will be reviewed.

3. Discuss any known 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

3. G-2, Disclosure 3.B, page 38 – Be prepared to review comments by independent peer reviewer, Dr. Joseph Minor, in Attachment B.

58. G-2, Disclosure 3.B, page 38, Attachment C, page 253 – "A Peer Review of Model 21 Implementation within CLASIC/2™". What is the significance of this model number? How does this relate, e.g. Model 23 or Model 27 on page 241, and the model currently under review by the Commission?

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

Professional Team Comments:

Reviewed resumes of new personnel:

- Hua He, Ph.D. in Civil Engineering with Minor in Statistics, Texas Tech University, Lubbock, Texas
- John Ford, Middlesex Community College, Technical Writing and Programming and University of Massachusetts, English Composition
- Justin A.W. Cox, Ph.D. Meteorology, University of Utah, Salt Lake City, Utah, B.S. Meteorology, Cornell University, Ithaca, NY
- Peter J. Sousounis, Ph.D., Meteorology, Penn State University, M.S. Meteorology, Mass Inst. Technology, B.S. Physics, Atmospheric Science, Drexel University.
- Chris Lehner, B.S. Mathematics, University of Oregon

Discussed the independent peer reviews performed on the model and their relevance to the current submission. Discussed the importance of including only timely reviews in the submission.

Clarified the model numbering system used in the Project Information Assumption Form (Attachment A) and in the Peer Review by Narges Pourghasemi (Attachment C).

Revised responses to be provided to the Commission:

- G-2.3B, page 38, include independent peer reviews pertinent to the current Standards, Disclosures, or Forms.
- Forms G-1 through G-5, pages 44-48, with updated signatures after revisions have been made to the original February 28, 2006 submission and reviewed by modeler personnel.

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Response to G-2.3A revised instead of response to G-2.3B. Revision reviewed by the Professional Team.

Revised Forms G-1 through G-5 received and reviewed by the Professional Team.

G-3 Risk Location

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

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

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

Audit

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

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

Pre-Visit Letter

4. G-3.C, page 40 – Be prepared to provide samples of the ZIP Code verification process for several selected ZIP codes.

Verified: YES

Professional Team Comments:

Reviewed the ZIP Code database update and the resulting minimal 0.1% increase in loss costs.

Reviewed the ZIP Code verification process and the quantitative checks and analyses performed on centroid movements. Reviewed ZIP Codes where the movement was greater than 1.0 mile. Reviewed correspondence with the ZIP Code vendor questioning the centroid movements.

Reviewed examples of ZIP Code movements showing how the centroids moved in response to the changes in the actual physical boundaries of the ZIP Codes.

Reviewed the computer code for verification of the vendor data.

Reviewed ZIP Code boundary maps showing the changes in boundaries and centroids.

G-4 Submission Specifications*

*(*Significant Revision)*

A. All units of measurement for model inputs and outputs shall be clearly identified.

B. All model outputs of length, wind speed, and pressure shall be in units of statute miles, statute miles per hour, and millibars, respectively.

C. Unless otherwise specified, wind fields generated by the model shall be used for completing relevant Forms and Tables in the submission.

Audit

1. The appropriateness of the units of measurement will be reviewed.

2. The information used in completing Forms and Tables in the submission will be reviewed.

Verified: YES

Professional Team Comments:

Appropriate units of measurement were verified throughout the review process.

Reviewed numerous data sources and processes for completing Forms and Tables in the submission, with particular reference to the underlying model wind field.

Discussed problems associated with differences between Excel and hard copies of submission. See Standard A-7.

G-5 Independence of Model Components

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

Audit

1. Demonstrate that the model components adequately portray hurricane phenomena and effects (damage and loss costs). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model

would not meet this Standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.

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

Verified: YES

Professional Team Comments:

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

Adjustment to the vulnerability functions was determined to be based on AIR damage assessments.

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

For validation of landfall and by-passing storm frequency in the stochastic storm set, the modeler shall use the latest updated Official Hurricane Set or the National Hurricane Center HURDAT as of June 1, 2005 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.

Audit

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

Pre-Visit Letter

5. Be prepared to describe how multiple event years are treated in the model. Is there any feedback to surface roughness?

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

Professional Team Comments:

Verified that there was no feedback to surface roughness for multiple events.

Viewed HURDAT tracks and maximum winds for historical by-passing storms for Florida as identified by AIR.

Discussed the new methodology used in determining the by-passing storms included as a modification to the Base Hurricane Set. Reviewed changes to the computer code used to select the storms included. The same methodology used for the stochastic set was also used to identify additional historical by-passing storms.

Viewed modeled windfield for historical storm, NoName 18 (1933).

Reviewed new procedures for identifying by-passing hurricanes implemented to reflect the changes in the definition of an event.

Verified that additional by-passing storms identified were used to modify the historical statistics for by-passing storms in Form M-1.

Revised responses to be provided to the Commission:

- M-1.2, page 50, revised to include current NHC HURDAT reference for Ginny (1963). Report provided on-site to the Professional Team.
- Revised page 51 to correct Standard notation in the header.

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Revised response to M-1.2 received and reviewed by the Professional Team.

M-2 Hurricane Characteristics

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

Audit

1. All hurricane characteristics used in the model will be reviewed.

2. Prepare graphical depictions of hurricane characteristics as used in the model. Describe and justify:
   - the data set basis for the fitted distributions,
   - the modeled dependencies among correlated characteristics in the wind field component and how they are represented,
   - the asymmetric nature of hurricanes,
   - the fitting methods used and any smoothing techniques employed.

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

4. The modeler will present time-based contour animations (capable of being paused) of wind and pressure fields to demonstrate scientifically reasonable wind field characteristics.

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

6. All modeler-specific scientific literature provided in Standard G-1 will be reviewed to determine acceptability.

7. Identify all external data sources that affect model generated wind fields.

Pre-Visit Letter

6. M-2, page 52 – What are the meteorological parameters in your model that are most critical in terms of loss sensitivity? What is their relative importance and how is this assessed? Show example calculations of such an assessment.

7. M-2, page 52 – The analysis of far field pressure, P_{env}, in a recent report "suggests a value of 1011 or 1012 rather than the commonly used 1013 mb value." However, when the analysis is further restricted to storms affected Florida, this conclusion is modified to be, "A case can be made that if a single value is to be used for P_{env}, *1010 mb or 1011 mb is more reasonable than 1013 mb*." What is the value of this parameter in the model and how does it vary? If this parameter does not vary, its effects will be wrapped into a shape or profile parameter. How is the variation of this profile parameter determined?

8. M-2, page 52 – The Standard has been modified relative to last year, but the response still includes the statement (removed from the Standard), "research conducted by AIR and accepted by the Commission."

9. M-2, Disclosure 1, page 52 – This disclosure was revised. The second required component is not addressed in the response.

10. M-2, Disclosure 2, page 52 – Describe each of the latitude relationships listed beginning at the bottom of page 52.

11. M-2, Disclosure 3, page 53 – The response is the same as last year and does not provide the required justification of *variation of the gradient to surface winds conversion factor relative to hurricane intensity*. Be prepared to discuss the variation of the gradient to surface winds conversion factor. Be prepared to justify the lack of spatial variation of the gradient to surface winds conversion factor (set at 0.9) with reference to Figures 8-10 of Franklin et al. (2003).

12. M-2, Disclosure 5, page 54 – Provide any analyses of track comparisons with 2004 storms.

13. M-2, Disclosure 8, page 56 – Provide any analyses of storm frequency comparisons after inclusion of 2004 storms.

14. M-2, Disclosure 9, page 57 – Be prepared to discuss the treatment of hurricane intensity at and immediately after landfall.

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

Professional Team Comments:

Discussed the meteorological variables in the model that are most critical to the characterization of hurricanes and the dependency of certain parameters on latitude.

Discussed the use of a constant far field pressure in the model and the sensitivity of loss cost to this value. Discussed AIR's future plans for sensitivity studies on far field pressure.

Reviewed the choice of statistical distributions for central pressure, forward speed, storm heading, Rmax, filling rate, air density coefficient, and Coriolis parameter and their dependencies on latitude.

Reviewed the conversion factor of 0.9 used for converting ten-minute gradient wind speed to ten-minute sustained surface winds and their justification for using this factor.

Reviewed track comparisons for 2004 hurricanes Charley, Jeanne, Frances, and Ivan with an event in the stochastic catalog.

Verified that Figure 5, page 55, was unchanged from previous submission (in which the modeler had included 2004 Florida storms).

Reviewed hurricane intensity at and after landfall and adjustments made to overland wind speeds for simulated events to local terrain exposure.

Reviewed animated contour plots.

Revised responses to be provided to the Commission:

- M-2, page 52, remove statement "or on research conducted by AIR and accepted by the Commission."
- M-2.1, page 52, response to address the historical data used for each of the characteristics identifying all storms used and the period used from the HURDAT database.
- M-2.9, page 57, revised to include adjustments made to overland wind speeds for simulated events.

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Revised responses for M-2, M-2.1, and M-2.9 received and reviewed by the Professional Team.

M-3 Landfall Intensity

Models shall use maximum one-minute sustained 10-meter wind speed 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 wind speed shall be within the range of wind speeds (in statute miles per hour) categorized by the Saffir-Simpson scale.

Saffir-Simpson Hurricane Scale:

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

Audit

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

Pre-Visit Letter

15. M-3, Disclosure 3, page 59 – Provide the maximum wind speed produced by the model for the *Florida hurricane in the stochastic storm set with the greatest over water intensity at the time of landfall*.

Verified: YES

Professional Team Comments:

Reviewed the hurricane characteristics from the upper limit wind speed produced by the model. The maximum wind speed for the highest intensity event over water is 168 mph.

Discussed update to the stochastic catalog to allow for a larger radius of maximum winds for intense hurricanes.

Reviewed simulated event characteristics sorted by central pressure.

Reviewed the minimum value of central pressure plotted on Figure 13 (Form M-3).

M-4 Hurricane Probabilities

A. Modeled probability distributions for hurricane intensity, forward speed, radii for maximum winds, and storm heading shall be consistent with historical hurricanes in the Atlantic basin.

B. Modeled hurricane probabilities shall reasonably 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. Modeled probabilities are compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical hurricane frequencies for the four regions of Florida and overall as provided in Form M-1 will be reviewed.

2. Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.

3. Describe and support the method of selecting stochastic storm tracks.

4. Describe and support the method of selecting storm track strike intervals. If strike locations are on a discrete set, show the landfall points for major metropolitan areas in Florida.

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

Pre-Visit Letter

16. M-4.A, page 60 – Be prepared to discuss the sentence, "Extreme values in the tail are reset so as not to be inconsistent with the historical record." in the penultimate paragraph.

17. M-4, Disclosure 2, page 62 – The text after the statement, "A completed Form M-1 is provided on page 70." appears to be left over from the previous submission. This now relates to another disclosure.

21. Form M-1, page 70 – Be prepared to discuss changes to the occurrence rates for Florida by-passing hurricanes given in Table 3.

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

Professional Team Comments:

Reviewed the method for sampling and limiting the lower bound on central pressure at landfall. Verified that statistical fit of Rmax to central pressure unchanged. Reviewed the process of truncating Rmax values within the new bounds given in Form M-3, Table 3.

Reviewed handling of by-passing storms in Form M-1, Table 3.

Revised response to be provided to the Commission:

- M-4.2, pages 62 & 63, text after first sentence to be removed.

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Revised response to M-4.2 received and reviewed by the Professional Team.

M-5 Land Friction and Weakening*

*(*Significant Revision due to Disclosures)*

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

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

Audit

1. Identify other variables in the model that affect over land wind speed estimation.

2. Maps depicting land friction effects are required. Describe the representation of land friction effects in the model. Describe the variation in decay rate over land used in the model.

3. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.

4. Transition of winds from over water to over land (i.e. landfall) will be reviewed.

5. Form M-2 will be reviewed.

Pre-Visit Letter

18. M-5.A, page 65 – For Figures 7 & 8, be prepared to discuss the differences between the previous and current submissions.

19. M-5, Disclosure 4, page 67 – Justify the timeliness of the land use land cover data cited in this response.

20. M-5, Disclosure 5, page 67 – Be prepared to show agreement between observations and windfields *generated with your standard model* for historical storm cases over land. It is acceptable to adjust the observed winds to the same averaging time assumed by the model, provided the same method of adjustment is used for all comparisons. It is not acceptable to refer to the Kaplan DeMaria decay rate without observed winds for the storms in question. The spatial distribution of winds should be compared for individual storms. Be prepared to explain any instances of poor agreement with reference to the meteorology of the case being considered.

22. Form M-2.C, page 73 – Provide the (single) maximum wind speed simulated by the model over Florida for each of the plots given in this form.

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

Professional Team Comments:

Reviewed comparisons of modeled versus adjusted observed wind speeds from tropical cyclone reports on data from observation stations for Charley, Frances, Ivan, and Jeanne.

Reviewed the differences in Figures 7 and 8 from last year's submission. This year's submission reflects a change in the method used to plot the friction factor data rather than a change to the data. Reviewed plots of the same data using the two different plotting methods showing the differences in the mapping. Discussed controls AIR plans to put in place to be sure all mapping is done using population-weighted centroids.

Discussed the land use and land cover data source, and the process for evaluating and updating/implementing. Reviewed the timeliness of these data and discussed AIR's plans for future updates.

Reviewed the process for computing the mean surface, one-minute wind speed for station observations reported using different heights and averaging times to model winds.

Reviewed comparisons of estimated maximum winds at landfall point from model, from NHC and from standardized surface wind records at Punta Gorda.

Reviewed AIR's analysis on different wind field model comparisons including multi-level numerical, slab numerical, parametric wind model pressure based and non-pressure based. Reviewed AIR's initial evaluation of a subset of these windfield methodologies for possible future implementation.

Reviewed model overland weakening rates.

Reviewed bar chart comparisons of adjusted observed wind speed and modeled wind speeds for a number of stations for Charley, Frances, Ivan and Jeanne (2004).

Reviewed spatial maps of Hurricane Andrew (1992) winds (Figures 43 and 44, pages 194 and 195). Reviewed copy of Reinhold et al. (1992) figure (AIR Figure 43) with modeled winds overlaid and observed point wind speeds printed.

Reviewed spatial map of Hurricane Charley (2004) modeled winds with adjusted observed winds annotated.

Revised responses to be provided to the Commission:

- M-5.5, page 67, to include additional items demonstrating weakening of the modeled hurricane over land.
- Form M-2, pages 72 & 73, to include the maximum winds simulated on each contour map.

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Revised responses to M-5.5 and Form M-2.C received and reviewed by the Professional Team.

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 wind speed 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

23. Form M-3.A, page 74 – Be prepared to explain the change in the ranges of Rmax provided.

Verified: YES

Professional Team Comments:

Discussed the changes in Rmax bounds. Reviewed scatter plots of central pressure versus Rmax comparing data considered in the previous and current versions of the model.

Reviewed changes in the computer code implementing the changes to the Rmax bounds.

Spatial maps of modeled wind speeds (Andrew and Charley) reviewed (from M-5) for differences in asymmetry due to storm forward motion.

VULNERABILITY STANDARDS – Fred Stolaski, 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 reasonable and be theoretically sound.

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

G. The minimum wind speed that generates damage shall be reasonable.

Audit

1. Historical data should be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. To the extent that historical data are used to develop vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete structural calculations shall be presented so

that a variety of different structure types and construction characteristics may be selected for review. The basis for expert opinion and original site inspection reports should be available for review.

2. Copies of any papers, reports, and studies used in the development of the vulnerability functions should be available for review. Copies of all public record documents used may be requested for review.

3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense should be available. The magnitude of logical changes among these items for a given wind speed shall be explained and validation materials should be available.

4. Justify the construction types and characteristics used, and provide validation of the range and direction of the variations in damage.

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

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

7. Describe how the duration of wind speeds at a particular location over the life of a hurricane is considered.

8. Form V-1 will be reviewed.

Pre-Visit Letter

24. V-1, page 79 – Be prepared to describe any changes made to the vulnerability functions in the past five years based upon engineering site inspections, insurance company claim data, etc.

25. V-1.E, page 80 – Explain the meaning of *(*Significant Revision)* at the end. The Florida Building Code (FBC 2001) reference is not included in the reference list provided on page 20.

26. V-1.E, page 80 – Justify the sentence, "That is, in areas where the building code is stronger, it is assumed that enforcement is also stronger."

27. V-1, Disclosure 1, page 81 – Be prepared to describe the process and software used in the procedures provided in Figure 14.

28. V-1, Disclosure 2, page 82 – Clarify the statement, "More recently AIR has begun receiving claims data from several client companies for 2004 hurricanes Charley, Frances, Jeanne, and Ivan."

29. V-1, Disclosure 2, pages 83-85 – Be prepared to explain the additional data points on the sample curves, for example Figures 16 and 17, relative to last year's submission.

30. V-1, Disclosure 3, page 87 – Be prepared to discuss the statement, "engineers validated the effects of wind duration on damage estimates," and show supporting data, reports, documentation, etc.

31. V-1, Disclosure 4, page 87 – Clarify reference to Figure 1.

32. Form V-1, page 93 – Be prepared to discuss the damage ratios provided in Parts A & B. For the wind speed range of 41-50, explain the values provided. For all the wind speed ranges in Part A, the estimated damage ratios are higher than last year's submission. In Part B, the estimates for wood frame and masonry are higher than last year's submission. However, the estimates for mobile home barely changed.

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

Professional Team Comments:

Reviewed changes to the vulnerability functions in the past five years, including why and when they were made. Verified no changes to the single family vulnerability functions have been made. Reviewed changes made to the apartment/condo and commercial vulnerability functions. Discussed addition of "age bands" to indicate year of construction differences.

Discussed implementation of the 2001 Florida Building Code.

Reviewed assumptions made concerning building codes and their enforcement.

Discussed on-going analysis on the data received from the 2004 storms.

Reviewed AIR's post disaster survey plan and a summary of their damage survey processes for 2004 and 2005. Reviewed the detailed survey form for residential and commercial construction. Reviewed examples from Hurricane Wilma damage surveys. Discussed enhancements made to the survey process after the 2004 post-disaster surveys. Discussed basis for selection of areas to be covered, make-up of survey teams, and information that is collected. Some of the areas surveyed for the 2004 storms were revisited six months later and extent of repairs were documented.

Documentation reviewed:

- AIR Damage Survey, Hurricane Dennis
- AIR Damage Survey, Hurricane Wilma in Florida, Team 3, October 2005
- AIR Damage Survey, Hurricane Frances

Reviewed internal processes for implementing the changes to the vulnerability functions in the model. Reviewed how data from site surveys was compared to other engineering judgment and experience in determining extent of changes. Discussed security procedures and QA testing.

Reviewed master file of vulnerability functions that are converted to binary files for use on a clients desktop.

Reviewed scatter plot of modeled versus actual mean damage ratio for wind speed.

Reviewed process and software used in the procedures provided in Figure 14 on page 81.

Discussed claims data received for 2004 hurricanes thus far and AIR's process for analyzing the available data and pending use of the data for model validation.

Reviewed duration as a parameter in calculating damage at a location. Reviewed damage surveys from Hurricane Frances validating the use of duration. Reviewed how damage is calculated at defined time intervals.

Reviewed comparisons between Charley and Frances for wind speed and duration. Reviewed actual damage photos showing comparable damage at vastly different wind speeds due to duration.

Reviewed damage ratio increases for changes in wood-frame and masonry apartment and condominium damage functions.

Reviewed the residential mean damage ratio broken down by years built from claims data for four different companies.

Reviewed computer code and logical component architecture for the minimum wind speed where damage occurs.

Reviewed and discussed the vulnerability function and associated computer code that will be presented to the Commission as part of the Trade Secret List.

Met with representative of field survey crews and reviewed folders of actual field reports. Discussed type of information available in the field and methods of documentation. Reviewed print-outs of data base of field information and verified the transfer of items from the field notes to the data base. Discussed process by which field information is combined with the available insurance data and then modified with engineering judgment.

Recommended to modeler that future submittals should include additions to Standard V-1, Disclosure 1, Figure 14 to add more details to bottom two boxes of the flow chart and include use of field survey information.

Revised response to be provided to the Commission:

- V-1.E, page 80, remove "*(*Significant Revision)* inadvertently left in from previous year's submission and clarify the assumptions made concerning building code enforcement.
- V-1.4, page 87, reference correct figure.
- Form V-1, page 93, correct values for the 41-50 mph wind speed range.

****

Revised responses to V-1.E, V-1.4, and Form V-1 received and reviewed by the Professional Team.

V-2 Mitigation Measures*

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

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

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

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

Audit

1. Form V-2 provides the information used in auditing this Standard.

2. Total effect on damage due to use of multiple mitigation measures will be reviewed and shown to be reasonable. Any variation in the change over the range of wind speeds for individual and multiple mitigation measures will be reviewed and shown to be reasonable.

3. Mitigation measures used by the model that are not listed as required in this Standard will be disclosed and shown to be theoretically sound and reasonable.

Pre-Visit Letter

33. Form V-2, page 97 – Be prepared to discuss and show documentation on methods used to complete the form. Explain the values provided for Mitigated Structure at various wind speeds in relation to the sum of the individual Mitigation Measures added to the Base Structure. Percentage mark symbols should be removed in the form.

34. Form V-2, page 98 – Wind speed in title block for the last section in Table 6 is incorrect.

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

Professional Team Comments:

Reviewed percentage change in damage rates at different wind speeds with mitigation features including roof covering, roof deck attachment, roof anchorage, and window protection individually and then all four mitigation features together on the base structure.

Revised response to be provided to the Commission:

- Form V-2, Table 6, page 98, correct title block in last section.

****

Revised Form V-2, Table 6 received and reviewed by the Professional Team.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs*

*(*Significant Revision)*

Modeled loss costs shall reflect all damages from storms that reach hurricane strength and produce minimum damaging wind speeds 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, ~~Contingent upon additional documentation provided to the Commission~~ Additional documentation received**

Professional Team Comments:

Discussed how damage from modeled storms are excluded or included in the calculation of loss costs.

Revised responses to be provided to the Commission:

- Response to Standard A-1, page 101.
- A-1.1, page 101, clarify how damage from modeled storms is excluded or included in the calculation of loss costs.

****

Revised responses to Standard A-1 and A-1.1 received and reviewed by the Professional Team.

A-2 Underwriting Assumptions

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

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

Audit

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

Pre-Visit Letter

35. A-2.A, page 102 – Provide analyses of insurance data from 2004 storms. Provide a more responsive answer to this item.
36. A-2.B, page 102 – Provide a detailed description of the use of the Project Information Assumption Form relative to data from 2004 storms.

37. A-2, Disclosure 1, page 102 – Describe any geographical differences in building stock distribution assumptions used to define "unknown" construction.

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

Professional Team Comments:

Reviewed correspondence between AIR and clients regarding the claims data for appropriateness of adjustments, edits, inclusions or deletions and for verification of assumptions regarding demand surge in data.

Reviewed AIR's processes for preparing the claims data for modeling including any adjustments, edits, inclusions or deletions to the data.
Reviewed the Project Assumption Form, its purposes and ways it serves as a control checkpoint for the data and assumptions used in an analysis, what the form documents, and how it is completed for validation data.

Verified there are no geographical differences in AIR building stock distribution assumptions used to define "unknown" construction.

Reviewed new claims data received by coverage and by policy.

Reviewed correspondence with clients stating that the claims data is still not fully developed and that additional data is expected from several large clients.

Revised response to be provided to the Commission:

- Response to Standard A-2.A, page 102

****

Revised response to A-2.A received and reviewed by the Professional Team.

A-3 Loss Cost Projections

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

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

C. Loss cost projections shall not explicitly include demand surge.

Audit

1. Demonstrate how the presence of demand surge has been considered in any analysis where Hurricane Andrew losses are used for development or verification of the model or its output. Demonstrate how demand surge is considered in any other data used in the development or verification of the model.

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

Verified: YES

Professional Team Comments:

Verified demand surge was not explicitly included in producing the loss costs.

Reviewed demand surge assumptions made when reviewing and processing claims data.

A-4 User Inputs

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

Audit

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

2. All insurer inputs and assumptions will be reviewed.

Pre-Visit Letter

38. A-4, Disclosure 2, pages 108-109 – Provide cited material to Professional Team.
    - Page 108, A-4.2 – A copy of the Preparer's Guide will be available to the Professional Team during its on-site visit. A copy of the User's Guide will be available to the Professional Team during its on-site visit.

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

Professional Team Comments:

Reviewed correspondence with clients documenting the delays in receiving and finalizing 2004 claims data.

Reviewed UNICEDE® /px Data Exchange Format Preparer's Guide documenting the process used to transfer client exposure and claims data into the model.

Reviewed CLASIC/2™ User's Guide manual documenting the analysis options available for generating modeled loss results.

Revised response to be provided to the Commission:
- A-4.2, page 109, remove incorrect Chapter reference in the CLASIC/2™ User's Guide describing the analysis options that may be selected for generating loss results.

****

Revised response to A-4.2 received and reviewed by the Professional Team.

A-5 Logical Relationship to Risk

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

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

C. Loss costs cannot increase as friction or roughness increase, all other factors held constant.

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

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

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

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

H. The relationship of loss costs for individual coverages, (e.g., structures 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, A-5 and A-6 will be used to assess coverage relationships.

Pre-Visit Letter

44. Form A-1, page 132 – Be prepared to discuss the magnitude of changes in the Coverage D column.

45. Form A-4, page 140 – Verify changes to Loss Costs for storms in 1945 and 1946 in Table 13.

46. Form A-5, page 144 – Verify value for ZIP Codes 33924 and 34228 added and 34997 missing.

47. Form A-6, page 147 – Verify Total Loss values for range in excess of 29,000 plus the change in the Total values.

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

Professional Team Comments:

Reviewed the changes in Coverage D. Reviewed underlying damage functions relative to ALE.

Reviewed loss costs for storms in 1945 and 1946 provided in Table 13.

Reviewed Form A-5. Changes in percentage of losses by ZIP Code are due to the recalculation of ZIP Code population centroids and appropriately updating the weighting of the physical parameters associated with each ZIP Code. Reviewed specific ZIP Codes 33924, 34228, and 34997 due to possible anomalies.

Verified all loss values that were in question.

Reviewed results in Form A-4.

Revised response to be provided to the Commission:

- Form A-4, page 140.

****

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

A-6 Deductibles and Policy Limits*

*(*Significant Revision)*

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

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

Pre-Visit Letter

39. A-6.C, page 120 – Provide a detailed description of the process used to ensure that deductibles are calculated in accordance with s. 627.701(5)(a), Florida Statutes.

Verified: YES

Professional Team Comments:

Reviewed the process for how the annual deductible is calculated and applied.

Reviewed the code in the software where the annual deductible is applied.

Discussed how policy limits are handled.

Reviewed map showing the impact on loss costs of implementing the annual deductible.

A-7 Contents

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

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed calculations used to derive contents loss costs.

Contents losses reported separately by clients.

A-8 Additional Living Expense (ALE)*

*(*Significant Revision)*

A. The methods used in the development of Additional Living Expense (ALE) loss costs shall be actuarially sound.

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

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

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:

Reviewed process and calculations used to develop ALE loss costs taking into consideration the time it takes to repair damage, exclusive of the effects of demand surge.

A-9 Output Ranges

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

B. All other factors held constant:

1. ***Output ranges produced by the model shall reflect lower loss costs for masonry construction versus frame construction.***
2. ***Output ranges produced by the model shall reflect lower loss costs for residential risk exposure versus mobile home risk exposure.***
3. ***Output ranges produced by the model shall reflect lower loss costs, in general, for inland counties versus coastal counties.***
4. ***Output ranges produced by the model shall reflect lower loss costs, in general, for northern counties versus southern counties.***

Audit

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

2. The modeler will be required to justify the following:
   a. Changes from the prior submission of greater than five percent in weighted average loss costs for any county.
   b. Changes from the prior submission of five percent or less in weighted average loss costs for any county.

3. Output Ranges will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.

4. Anomalies in the output range data will be reviewed and shall be justified.

Pre-Visit Letter

40. A-9, Disclosure 1, page 130 – Verify that the illustration for Table 11 holds for the yellow shaded cases in the Output Ranges.

41. A-9, Disclosure 2, page 130 – Describe how each refinement contributes to the percentages listed in Form A-8.

42. A-9, Disclosure 2, page 130 – Be prepared to review the updating of the Rmax distributions and generation of by-passing storms.

43. A-9, Disclosure 3, page 131 – Provide any documentation generated by AIR engineers on 2004 and 2005 post-disaster surveys.

Note: items 44-47 are covered under other standards.

48. Form A-7, page 149 – Verify total of 808 zero-weighted ZIP Codes in Table 15.

49. Form A-7, pages 152-186 – The printed form has the county Miami-Dade whereas the electronic version has Dade county. Note for Frame and $0 Deductible Structure:

	Printed form Desoto	Electronic version Dade
LOW	1.316	1.316
HIGH	1.508	1.508
WGHTD AVE	1.324	1.324

Review all aspects of the model involving FIPS codes and tie-ins to ZIP Codes. Further analysis of output ranges submitted must be suspended until this issue is resolved.

50. Form A-7, page 153 – Be prepared to discuss major change for Frame Loss Costs in Franklin County for $0 Deductible Structure.

51. Form A-8, page 189 – Provide details relative to all changes greater than 15%, including estimates of each specific contributor to changes.

Verified: YES

Professional Team Comments:

Discussed individual items contributing to changes.

Reviewed effects of updates to Rmax bounds for Cat 4 and Cat 5 storms and by-passing storms.

Reviewed process and documents relative to processing of information from post disaster surveys.

Verified zero weighted ZIP Codes.

Reviewed reasons for inconsistencies between Excel and hard copies of submission Forms. Discussed ways to prevent reoccurrence of problem in future years.

Reviewed Franklin County results.

Reviewed changes greater than 15% which are driven by the revisions to apartment/condo damage functions for low rise wood frame and masonry constructions.

Revised Form A-7 reviewed.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods.

Audit

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

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

Pre-Visit Letter

52. S-1, Disclosure 3, page 195 – Although the origins of the sample input characteristics can be traced to the Professional Team, the numbers are officially supplied by the Commission through the *Report of Activities*.

53. S-1, Disclosure 4, page 195 – Review 2004 season data.

54. Form S-1, page 214 – Review changes in values.

55. Form S-2, page 215 – Review changes in values provided in Parts A and B.

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

Professional Team Comments:

Reviewed 2004 hurricane claims data by different coverage. Verified data are not fully developed and additional data are expected from some large clients.

Reviewed process for determining central pressure for by-passing storms.

Reviewed Form S-1 and a revised Form, page 214, is to be provided to the Commission.

Reviewed Form S-2 and discussed the largest impact due to the changes made to Rmax. The changes in S-2 are consistent with the changes made to the catalog.

Reviewed the binder containing documentation on statistical analyses.

Revised response to be provided to the Commission:

- S-1.3, page 195, remove attribution to the Professional Team.
- Form S-1, page 214.

****

Revised responses to S-1.3 and Form S-1 received and reviewed by the Professional Team.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed results of the sensitivity studies involving loss costs performed on model input variables including central pressure, Rmax, and forward velocity. Reviewed standardized regression coefficients for loss cost by storm category for each of the input variables.

Discussed sensitivity studies performed on Rmax.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed results of previous uncertainty analyses and determined that no new studies have been performed.

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

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 and results of the sampling of the stochastic storm set for this year's submission are verified.

S-5 Replication of Known Hurricane Losses

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

Audit

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

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

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

4. Form S-3 will be reviewed.

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

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

Professional Team Comments:

Reviewed validation comparisons provided in Form S-3 and verified no changes.

Revised response to be provided to the Commission:

- Form S-3, page 217 with correction to header in Comparison #4 for Coverage C. Changes in Form S-3 reflect the new stochastic catalog.

****

Revised Form S-3 received and reviewed by the Professional Team.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-4 will be reviewed.

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

Verified: **YES**

Professional Team Comments:

Reviewed results provided 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) 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.

Pre-Visit Letter

56. Pages 222-232 – Provide all documents, binders, examples, demonstrations, etc. referenced to be made available to the Professional Team.
    - Page 222, C-1.A – A primary document binder containing fully documented sections for each computer standard is available for inspection by the Professional Team.
    - Page 222, C-1.B – All computer software, data files, and databases are fully documented and such documentation shall be available for review by the Professional Team.
    - Page 222, C-1.C – Documentation is provided via in-line detailed comments and external higher level documentation that will be available for review by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the primary document binder containing:

- User guide
- Release notes summarizing the changes made between software versions
- Installation, system configuration, and update instructions
- User manual
- Reference guide
- Data exchange format preparer's guides

Reviewed documentation for the ZIP Code re-mapping procedure, updates to the stochastic catalog for Rmax and by-passing storms, and updates to the damage functions for apartment/condos.

Reviewed Project Management Chart.

Reviewed documentation on the annual deductible implementation for CLASIC/2 Version 20050120.

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

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

Pre-Visit Letter

56. Pages 222-232 – Provide all documents, binders, examples, demonstrations, etc. referenced to be made available to the Professional Team.
    - Page 223, C-2 – CLASIC/2 documentation specifying model requirements and computer implementation for each software component is available for verification by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the requirements binder containing:

- Features of CLASIC/2
- Requirements summary

- Software requirements and specifications
- Database specifications
- Software coding standards and guidelines for Fortran and C++
- ZIP Centroid creating summary and verification
- Technical documentation guidelines

Reviewed requirements for multiple deductible modification.

C-3 Model Architecture and Component Design

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

Audit

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

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

Pre-Visit Letter

56. Pages 222-232 – Provide all documents, binders, examples, demonstrations, etc. referenced to be made available to the Professional Team.
    - Page 224, C-3 – This document is available to the Professional Team during its site visit.

Verified: YES

Professional Team Comments:

Reviewed model architecture and component design documentation.

Reviewed flowchart for multiple deductible code.

Reviewed flowchart for by-passing storm procedure.

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.

Audit

1. The interfaces and the coupling assumptions will be reviewed.

2. Provide the documented coding guidelines and confirm that these guidelines are uniformly implemented.

3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.

4. The traceability among components at all levels of representation will be reviewed.

5. The following information shall be available and will be reviewed for each component, either in a header comment block, source control database, or the documentation: component name, date created, dates modified and by whom, purpose or function of the component, and input and output parameter definitions.

6. The table of all software components as specified in C-4.D will be reviewed.

7. Model components and the method of mapping to elements in the computer program will be reviewed.

8. Comments within components will be examined for sufficiency, consistency, and explanatory quality.

Verified: YES

Professional Team Comments:

Reviewed code, comments, and documentation for the by-passing storm and ZIP Code re-mapping subroutines.

Reviewed software metrics table for subroutines associated with the ZIP Code re-mapping.

Reviewed implementation binder containing:

- AIR Tropical Cyclone Model for the U.S. Gulf and East Coasts
- Error codes documentation
- Flowcharts documenting the flow of various functions implemented in the hurricane model and traceability to the code level
- Process for testing the hurricane model
- Data files for the hurricane model documentation
- Software engine and model documentation
- Line count statistics table for ZIP Code re-mapping, by-passing storm code, and user interface code
- Line counts for CLASIC/2 Engine and Model 21 regarding the individual modules in each of the three major components.

Reviewed multiple deductible implementation.

Reviewed code for change to Rmax bounds.

Reviewed code associated with Standard V-1, Audit item 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.

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.

Pre-Visit Letter

56. Pages 222-232 – Provide all documents, binders, examples, demonstrations, etc. referenced to be made available to the Professional Team.
    - Page 227, C-5.A – Examples of these verification procedures, including code inspections, reviews, calculation crosschecks, walk-throughs, and the use of logical assertions and exception-handling mechanisms in the code, are described with the documentation, can be shown to the Professional Team during its on-site visit.
    - Page 288, C-5.B – Materials that demonstrate SQA processes will be available to the Professional Team for review during their on-site visit.

57. C-5.B-4, page 227 – Demonstrate that sufficient testing has been performed to ensure that all components have been executed at least once.

Verified: YES

Professional Team Comments:

Reviewed catalog generation code testing procedure and documentation.

Reviewed process and documentation for software verification and validation.

Reviewed test classifications and plans for exposure, model output, storm catalog, construction occupancy, age, height, and mitigation features.

C-6 Model Maintenance and Revision

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

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

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

Audit

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

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

Pre-Visit Letter

56. Pages 222-232 – Provide all documents, binders, examples, demonstrations, etc. referenced to be made available to the Professional Team.
    - Page 230, C-6.1 – We are prepared to demonstrate these systems and methodologies during the Professional Team on-site visit.

Verified: YES

Professional Team Comments:

Reviewed the data control process and documentation for model maintenance and revision.

Reviewed the policy for model revision.

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.

Verified: YES

Professional Team Comments:

Reviewed the policy and procedures for security of software, code, data, and documentation.