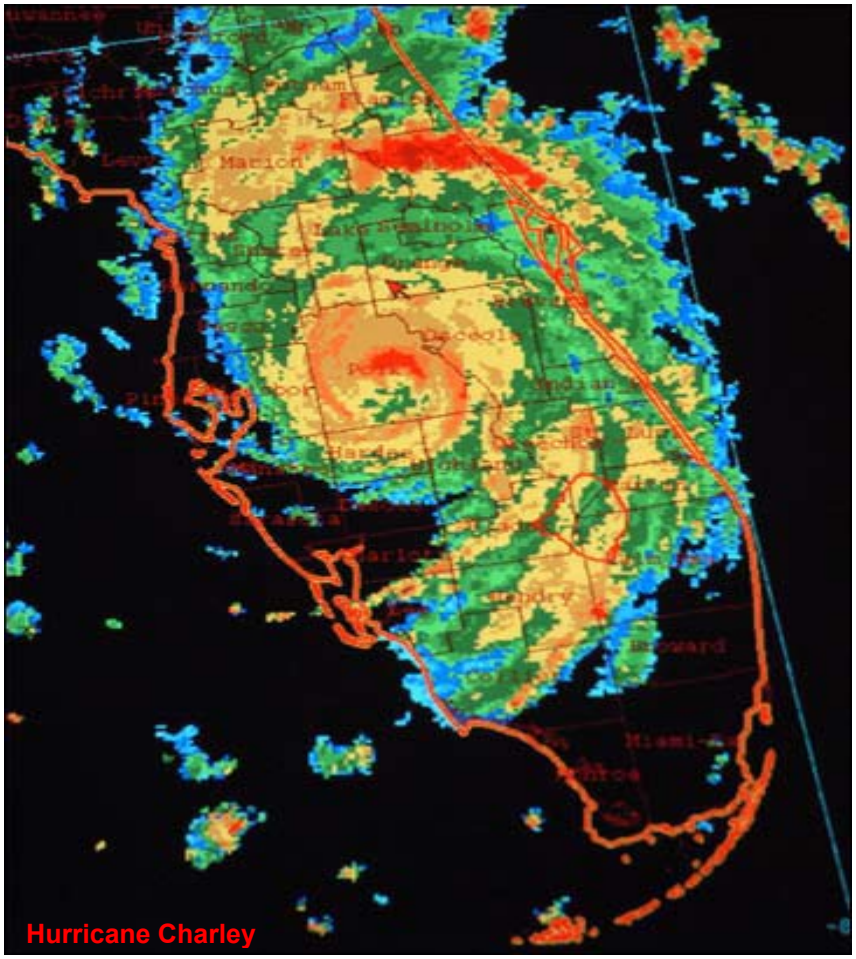
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2004 Standards

AIR Worldwide Corporation

On-Site Review
April 21 – 23, 2005

On April 21 – 23, 2005 the Professional Team visited on-site at AIR Worldwide Corporation in Boston, Massachusetts. The following individuals participated in the review.

AIR

Chattaraj Bhaskar, Manager, Core Products Quality Assurance
Matt Boland, Senior Quality Assurance Manager
Peter S. Dailey, Ph.D., Manager, Atmospheric Science
Glen Daraskevich, Manager, Research and Modeling
Boris Davidson, Chief Software Architect
Michele D. Fischer, Senior Research Meteorologist
Jayanta Guin, Ph.D., Vice President, Research and Modeling
Judith A. Hasbrouck, Senior Technical Writer
Julia M. Hersey, Senior Technical Writer
Atul C. Khanduri, Ph.D., Manager, Wind Risk Modeling
David Lalonde, FCAS, FCIA, MAAA, Senior Vice President
S. Ming Lee, Senior Vice President
Greta M. Ljung, Ph.D., Senior Research Statistician
Shangyao Nong, Ph.D., Senior Research Scientist, Meteorology
Mohit Pande, Senior Research Engineer
Miriam E. Perkins, ACAS, MAAA, Actuarial Analyst
John Rowe, Senior Research Engineer
Larry Trudeau, Software Engineering Manager
Paul Whelan, Research Associate

Professional Team

Mark Johnson, Ph.D., Statistician, Team Leader
Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
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. AIR began with a discussion of the changes to the model from the previous year which include:

- Historical catalog update through 2004
- ZIP Code database update
- Update stochastic catalog to reflect new landfall frequency, the locations of the new landfalls, and the intensity at landfall of the new storms

The impact of these model updates on the statewide loss costs were discussed.

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

- Page 22, G-1.4, dates of HURDAT database and Disclosure M-2.9 on page 60 revised to be consistent with response provided in Disclosure M-4.1 on page 65.

- Page 35, G-2.2.A, include Glen Daraskevich in the table for Computer Science.
- Page 37, G-2.2.B, include Glen Daraskevich in list of new employees.
- Pages 46-50, Forms G-1 through G-5 with updated signatures after revisions made to the original February 28, 2005 submission.
- Pages 52&53, M-1.2, dates of National Hurricane Center reports for Charley, Gaston, and Ivan updated.
- Page 55, M-2.3, remove factor greater than 1.0 statement.
- Page 57, M-2.7, provide complete time frame for hurricane frequency distribution.
- Page 58, M-2.8, include climatological studies that were utilized for landfall location.
- Page 60, M-2.9, dates of HURDAT database revised to be consistent with response provided in Disclosure M-4.1 on page 65.
- Page 63, M-4.A, revised to remove phrase "available to the Commission" in reference to accepted scientific literature and to include the complete time frame used for calculating Rmax.
- Page 65, M-4.1, dates of HURDAT database revised for consistency.
- Page 85, V-1.1, revised to update flow chart with actual process.
- Page 91, V-1.4, provide date for second Friedman reference.
- Page 92, V-1.4, provide date for Marshall reference.
- Page 93, V-1.4, provide date for Wiggins reference.
- Page 94, V-1.5, Table 6, revised to clarify descriptions of reinforced concrete and steel for residential and apartment or condominium buildings.
- Page 103, Form V-2, revised to correct "¾" values
- Page 107, A-2.1, revised to remove 72 hours clause.
- Page 129, A-8.C, Figure 31 revised for correct vertical axis label.
- Page 134, A-9.2, revised to reflect changes to the stochastic catalog, the handling of bypassing storms, and the change to central pressure distribution.
- Pages 156-190, Form A-7, revised to correct for Miami-Dade county location in file.
- Page 198, S-1.2, dates of National Hurricane Center reports for Charley, Gaston, and Ivan updated.
- Page 218, Form S-1, revised to provide explanation of modeled probability in footnote.

All of the above revisions are included in the revised submission received on 5/19/05.

Report on Deficiencies

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

1. References. There are numerous places in the submission in which cited material is incomplete (e.g., publication dates). In particular:

   G-1. Disclosure 4. Page 21. Cry reference date.
   Page 22. Cross and Thorton reference date.
   Page 22. Friedman (second of three) reference date.
   Page 23. Marshall reference date.
   Page 24. Wiggins reference date.

   G-4. Disclosure 1. Page 44. Reference relating to the ten-minute averaging to one-minute sustained wind is neither provided nor is the conversion factor *disclosed*.

   V-1. Disclosure 4. Page 91. Friedman (second of three) reference date. Friedman's name is spelled differently in first reference.

   V-1. Disclosure 4. Page 92. Marshall reference date.

   V-1. Disclosure 4. Page 93. Wiggins reference date.

   Revised pages submitted:
   - Pages 21 and 60, Cry reference completed.
   - Page 22, dates provided for Cross and Thorton reference and Friedman reference.
   - Page 23, date provided for Marshall reference.
   - Page 24, date provided for Wiggins reference.
   - Page 44, conversion factor and reference provided.
   - Page 91, first Friedman reference corrected, year still needed for second Friedman reference.

   Revisions still needed providing reference dates for second Friedman reference (page 91), Marshall reference (page 92), and Wiggins reference (page 93). These revisions to be provided to the Commission.

   Revised pages 91-93 received with dates provided for the second Friedman, the Marshall, and the Wiggins references.

2. G-2. Disclosures 2.D. Page 39. The review and vita of Dr. Lyons is missing in Attachment B.

   Revised pages 39 and 314-322 submitted providing the review and vita of Dr. Lyons as Attachment E.

3. G-2. Disclosure 3.B. Page 40. Dr. Minor performed a vulnerability review rather than a hurricane review.

   Revised page 40 submitted with correction provided for reference to Dr. Minor's vulnerability review.

4. M-2. Disclosure 3. Page 55. Justification is absent in the first paragraph of the response. Describe how the inherent uncertainties are treated. The second paragraph is the same as mentioned in G-4 above. Conversion factor should be disclosed.

   Page 55 submitted with revised response provided for Disclosure 3.

5. M-2. Disclosure 7. Page 57. The response, "The procedure is documented in the meteorological literature." is *insufficient*. A specific reference is required.

   Page 57 submitted with revised response provided for Disclosure 7.

6. V-2, A. Page 96. Last sentence of paragraph 2 is incomplete.

   Page 96 submitted with revised response to Part A.

7. Form V-1, A. Page 99. The entries labeled N/A are *insufficient*.

   Revised page 99, Form V-1 submitted.

8. Form V-2. Page 103. The no skylight and no door covers cases were separated into two cases, which is not what was requested.

   Revised pages 103-105, Form V-2 submitted.

9. A-4, Disclosures 3 and 4. Page 115. The responses to these two disclosures are identical. Was this the intention?

   Page 115 submitted with revised response provided for Disclosure 4.

10. A-5, D. Page 116. Form M-3 is not correct.

    Revised page 116 submitted with corrected reference to Form A-3 provided.

11. Form A-2.B. Page 138. ZIP Codes in the sample data set that the model does not recognize as "valid," are to be provided as a list in the submission document and an indication of how it was mapped or not modeled.

    Revised pages 138 and 323-325 submitted with the re-mapped ZIP Codes provided as Attachment F.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

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

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

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

Pre-Visit Letter

1. G-1.2, page 16 – Be prepared to discuss any additional validation work that has been performed this year.

2. G-1.2, page 18 – Be prepared to review the extent to which the recent hurricane season was incorporated into this year's version of the model.

3. G-1.2, page 19 – Be prepared to discuss the case for explicit consideration of duration.

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

Professional Team Comments:

Reviewed the validation work that AIR performed in the past year including damage surveys for each of the four hurricanes that impacted Florida in 2004 and detailed claims data that is being collected and analyzed.

Reviewed the general framework for duration being a part of the model where total damage is accumulated for all damaging hours. Reviewed analyses of damage ratios comparing Hurricane Charley and Hurricane Frances considering wind speed and the duration of the damaging winds.

Documentation reviewed:

- The Effect of Wind Duration on Structures in the AIR Tropical Cyclone Model, Confirming Evidence from Hurricane Georges, AIR Special Report, March, 1999

Response to G-1.4, page 21, revised to update dates of HURDAT database to be consistent with the response provided in Disclosure M-4.1 on page 65 to be provided to the Commission.

Revised response to G-1.4, page 21 received and reviewed by the Professional Team.

G-2 Qualifications of Modeler Personnel and Independent Experts

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

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

Audit

1. The professional vitae of modeler personnel and independent experts responsible for the current model and information on their predecessors if different than current personnel will be reviewed. Background information on individuals providing testimonial letters in the submission shall be provided.

2. Forms G-1, G-2, G-3, G-4, G-5, G-6, and all independent peer reviews of the model will be reviewed.

3. Discuss any incidents where modeler personnel have been found to have failed to abide by the standards of professional conduct adopted by their profession.

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

Professional Team Comments:

Reviewed following resumes:

- Vineet Kumar Jain, Ph.D. in Civil and Environmental Engineering, Major in Environmental Systems, Minors in Applied Mathematics, Risk Analysis, Communication and Policy, Cornell University, College of Engineering, Ithaca, NY; Mtech in Environmental Engineering and Management, Indian Institute of Technology Kanpur, India; Bachelor of Engineering in Civil Engineering, Punjab Engineering College Chandigarh, India
- Judith A. Hasbrouck, M.S. in Management of Information Technology, Lesley University, Cambridge, Massachusetts; B.S. in Education, Lesley University, Cambridge, Massachusetts
- Julia Meitov Hersey, Masters in Slavic and Eastern Languages and Literature, Boston College, Chestnut Hill, Massachusetts; B.A. in Comparative Literature, Simmons College, Boston, Massachusetts; Moscow State University, Moscow, Russia, School of Journalism
- Glenn Hevron, MBA, Southern Methodist University; B.S. Physics and Computer/Information Sciences, Texas A&M University
- Larry Trudeau, M.S., Boston University, Boston, Massachusetts, Finishing Degree Program; B.S., Bryant College, Smithfield, Rhode Island
- Glen Daraskevich, MS in Information Systems, Boston University Graduate School of Management, Boston, Massachusetts; MS in Environmental Engineering, University of New Haven, West Haven, Connecticut; BS in Civil Engineering, University of Connecticut, Storrs, Connecticut

Response to G-2.2.A revised to include Glen Daraskevich in the table for Computer Science to be provided to the Commission.

Revised responses to G-2.2.A, page 35 and G-2.2.B, page 37 received and reviewed by the Professional Team.

Revised Forms G-1 through G-5 with updated signatures after revisions have been made to the original February 28, 2005 submission to be provided to the Commission.

Revised Forms G-1 through G-5, pages 46-50 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-3.1, page 42 – Be prepared to discuss AIR's master database of ZIP codes from 1990 to 2003.

5. G-3, page 42 – How does this year's submission relate to the material that was reviewed last year regarding the centroids?

Verified: YES

Professional Team Comments:

Reviewed the update to the ZIP Code centroids, the validation process, and the mapping of invalid ZIP Codes.

Reviewed the computer code and output files from the ZIP Code validation and re-mapping processes. Reviewed examples of explicit mapping. Reviewed process for checking against vendor resolutions.

Reviewed ZIP Code movement statistics for movement of ZIP Codes greater than 1 mile between database releases. Reviewed map of centroid movement in the update to database.

Reviewed ZIP Code boundary maps showing the changes in boundaries and centroids showing the current population, prior population, 2004 ZIP Code, county boundary, and AIR determined location.

Reviewed the correlation between census blocks and changes in ZIP Code boundaries.

G-4 Units of Measurement

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

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

C. Wind inputs to the damage function shall be in units consistent with currently used wind measurement units and/or shall be converted using standard meteorological/engineering conversion factors.

Audit

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

Pre-Visit Letter

6. G-4, page 44 – What role does the 10min to 1min wind averaging play in the model for the North Atlantic?

Verified: YES

Professional Team Comments:

Appropriate units of measurement were verified throughout the review process.

Reviewed process for converting 10-minute averaging wind speed to 1-minute sustained winds. Reviewed the gust factor and following documentation:

- Simiu, E., and Scanlan, R.H., “Wind Effects on Structures”, Wiley-Interscience, 1996
- N. J. Cook, “The Designers Guide to Wind Loading of Building Structures, Part 1”, Building Research Establishment Report, Butterworth, London, England, 1985
- ESDU Engineering Sciences Data, “Wind Engineering”, 1994

G-5 Independence of Model Components

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

Audit

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

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

Pre-Visit Letter

7. G-5, page 45 – Be prepared to show documents supporting the independence of wind speed and damage model verification.

Verified: YES

Professional Team Comments:

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

Reviewed graphical comparisons of observed wind speeds to modeled wind speeds for Hurricanes Gloria (1985), Hugo (1989), Bob (1991), Andrew (1992), Erin (1995), Opal (1995), Bertha (1996), Fran (1996), Georges (1998), and Isabel (2003).

Reviewed graphical comparison of damage function validation using detailed loss data from client companies.

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Official Hurricane Set*

*(*Significant Revision)*

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

Audit

1. The modeler will provide the hurricane set used. Failure to update the hurricane set to the most recent year is not acceptable. For revisions to HURDAT, only complete incremental revisions are acceptable.

2. The additional information from the National Hurricane Center or from peer reviewed atmospheric science literature will be reviewed.

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

Professional Team Comments:

Reviewed the update to the historical storm set and the stochastic catalog for the 2003 and 2004 hurricane seasons.

Response to M-1.2, pages 52 & 53, revised with updated dates for references to National Hurricane Center reports for Charley, Ivan, and Jeanne to be provided to the Commission.

Revised response to M-1.2, pages 52 & 53 received and reviewed by the Professional Team.

M-2 Hurricane Characteristics*

*(*Significant Revision)*

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

Audit

1. Identify all of the hurricane characteristics used in the model. For hurricane characteristics modeled as random variables describe the probability distributions used.

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

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

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

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

6. Map the location of the peak hurricane intensity compared to the western most point of a random selection of recurving storm tracks for hurricanes effecting Florida.

7. All modeler-specific scientific literature provided in Disclosure 9 will be reviewed to determine acceptability.

Pre-Visit Letter

8. M-2.2, page 54 – Be prepared to discuss the independence of track angle and forward speed. Is track angle measured relative to north?

9. M-2.3, page 55 – Be prepared to discuss the (1) spatial consistency of the reduction factor used to convert between gradient and surface wind speeds and (2) the treatment of uncertainties.

10. M-2.6, page 56 – Do "open ocean" track distributions provide reasonable distributions of storm landfall frequency? How is a landfall distribution representative of the historical set ensured? How are bypassing storms generated in the model?

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

Professional Team Comments:

Reviewed the dependency of the air density coefficient on latitude.

Reviewed the conversion factor used for converting ten-minute averaging wind speed to one-minute sustained winds.

Reviewed following documentation:

- Simiu, E., and Scanlan, R.H., "Wind Effects on Structures", Wiley-Interscience, 1996
- N. J. Cook, "The Designers Guide to Wind Loading of Building Structures, Part 1", Building Research Establishment Report, Butterworth, London, England, 1985
- ESDU Engineering Sciences Data, "Wind Engineering", 1994

Reviewed scatter plot showing the independence of track angle and forward speed from stochastic events for Florida and adjacent states.

Reviewed gradient winds and mean surface wind speed profiles for stochastic storms of varying intensity.

Reviewed bounds used to ensure consistency between historical and stochastic storms.

Discussed modeler review of radius to hurricane force winds.

Revised responses to be provided to the Commission:

- M-2.3, page 55 remove factor great than 1.0 statement.
- M-2.7, page 57 include complete time frame for hurricane frequency distribution
- M-2.8, page 58 include which climatological studies were utilized for landfall location
- M-2.9, page 60 update HURDAT database dates to be consistent with the response provided in Disclosure M-4.1 on page 65

Revised responses for M-2.3, page 55; M.2-7, page 57; M-2.8, page 58; M-2.9, page 60 received and reviewed by the Professional Team.

M-3 Landfall Intensity*

*(*Significant Revision)*

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

Saffir-Simpson Hurricane Scale:

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the method used to define a model event, including the handling of bypassing storms.

Reviewed revision methodology for landfall intensity when 2004 storms included in historical database.

Reviewed the hurricane characteristics from the upper limit wind speed storm produced by the model.

Reviewed the code for selection technique for bypassing storms.

Reviewed histograms comparing model-derived winds and observed winds for ten US landfalling storms.

Reviewed Form M-1.

M-4 Hurricane Probabilities*

*(*Significant Revision)*

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

B. Modeled hurricane probabilities shall reasonably reflect the Official Hurricane Set through 2003 for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).

Audit

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

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

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

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

5. Demonstrate the goodness-of-fit of distributions to historical hurricane characteristics.

6. Provide the source documents or any research performed to develop the functions used for simulating model variables or databases.

Pre-Visit Letter

11. M-4, page 63 – How are extreme values "reset so as not to be inconsistent with the historical record"? Which storm parameters are most often affected? How does this impact the uncertainty calculations in the model?

12. M-4, page 63 – Provide a reference for the lognormal distribution of hurricane forward speed. How does it mesh with Charley (2004)?

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

Professional Team Comments:

Reviewed the treatment of extreme values for central pressure, forward speed, track angle, and Rmax.

Reviewed how Hurricane Charley fit into the current model distribution for forward speed at landfall.

Reviewed methodology for assigning multiple stochastic storms to a simulated year.

Response to M-4.A, page 63, revised to remove phrase "available to the Commission" in reference to accepted scientific literature and to include the complete time frame used for calculating Rmax to be provided to the Commission.

Revised response to M-4.A, page 63 received and reviewed by the Professional Team.

Response to M-4.1, page 65, revised to update HURDAT database dates to be provided to the Commission.

Revised response to M-4.1, page 65 received and reviewed by the Professional Team.

M-5 Land Friction and Weakening

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

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

Audit

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

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

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

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

5. Form M-2 will be reviewed.

Pre-Visit Letter

13. M-5.2, page 69 – Be prepared to discuss how distance from the coast impacts intensity.

Verified: YES

Professional Team Comments:

Verified no change in the methodology for handling the overland weakening rate.

Verified no change to land use land cover dataset.

Verified that modeler employs an alternative treatment for fast moving storms.

Reviewed the results provided in Form M-2.

M-6 Logical Relationships of Hurricane Characteristics*

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

A. The radius of maximum winds shall reflect historical hurricane characteristics.

B. The magnitude of asymmetry shall increase as the translation speed increases, all other factors held constant.

C. The wind speed shall decrease with increasing surface roughness (friction), all other factors held constant.

Audit

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

Verified: YES

Professional Team Comments:

Reviewed Form M-3 table and Figure 13 and the treatment of Rmax in the model.

Reviewed scatter plots of radius of maximum winds versus central pressure, latitude and the associated correlation coefficients.

Reviewed the methodology for the regression model addressing relationship between Rmax and central pressure and latitude.

Reviewed formulation of wind asymmetry due to forward motion.

Further reviewed wind field comparisons for Florida storms.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

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

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

8. Form V-1 will be reviewed.

Pre-Visit Letter

14. V-1, page 83 – Be prepared to discuss and show documents indicating how the vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense are derived.

15. V-1.E, page 84 – Why is the response designated as a significant revision?

16. V-1.2, pages 87-89 – In general, it appears from the Figures 15-20 that losses are underestimated for low wind speeds and are overestimated for high wind speeds. Be prepared to explain this.

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

Professional Team Comments:

Reviewed the overview of the methodology for the development of the vulnerability functions.

Reviewed results of damage surveys from the 2004 storms.

Reviewed the overview of methodology for consideration of the 2001 Florida Building Code in the vulnerability functions.

Reviewed analysis of detailed claims data – validation by construction, coverage, total, individual company storm combination validation.

Reviewed damage ratio plots comparing actual versus simulated damage for structure and contents loss.

Reviewed the effect of duration on the vulnerability functions.

Reviewed ALE model methodology and flow chart for "estimating time element losses."

Reviewed basis for minimum wind speed that causes damage.

Reviewed construction class definitions.

Documentation reviewed:

- Existing Recommendations and Definitions on Disaster Insurance, Vit Karnik, The Geneva Papers on Risk and Insurance, Proceedings of the First Meeting of the International Working Group on Natural Disasters and Insurance (I), Vol. 9, No. 30, January 1984
- Reducing Vulnerability to Natural Hazards, Harold D. Foster, The Geneva Papers on Risk and Insurance, Proceedings of the First Meeting of the International Working Group on Natural Disasters and Insurance (I), Vol. 9, No. 30, January 1984
- Natural Hazard Risk Assessment for an Insurance Program, Don G. Friedman, The Geneva Papers on Risk and Insurance, Proceedings of the First Meeting of the International Working Group on Natural Disasters and Insurance (I), Vol. 9, No. 30, January 1984
- Analysis of Storm Damage Factors for Low Rise Structures, Ben L. Sill, Timothy A. Reinhold, and Ronald T. Kozlowski

Response to V-1.1 revised with updated flow chart showing correct step in process of cleaning and organizing detailed claims and loss data to be provided to the Commission.

Revised response to V-1.1, page 85 received and reviewed by the Professional Team.

Response to V-1.4 revised with dates provided for second Friedman reference, Marshall reference, and Wiggins reference to be provided to the Commission.

Revised response to V-1.4, pages 91-93 received and reviewed by the Professional Team.

Response to V-1.5, Table 6 revised to clarify descriptions of reinforced concrete and steel for residential buildings to be provided to the Commission.

Revised response to V-1.5, Table 6, page 94 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

17. V-2.A, page 96 – Explain the difference in 22 building classes on page 96 and 24 in Appendix D.

18. Form V-2.C, page 101 – Why is duration not needed here?

19. Form V-2, page 103 – Be prepared to discuss why enhanced anchor bolts or straps do not have any measurable beneficial effects for low percentages.

20. Form V-2, page 103 – For the mitigated structure cell at the bottom of Form V-2 (structure), define which type of shutters are used.

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

Professional Team Comments:

Reviewed results of damage surveys showing the positive effect of using mitigation measures and adhering to the new Florida building code.

Reviewed the 22 building features included in the model that have an impact on building losses.

Reviewed in detail the results for the various mitigation factors provided in Form V-2.

Reviewed mitigated structure characteristics including shutters.

Reviewed impact of multiple mitigations versus individual mitigation.

Revised Form V-2 with "¾" values corrected to be provided to the Commission.

Revised Form V-2, page 103 received and reviewed by the Professional Team.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs*

*(*New Standard)*

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

Any variations in modeled loss costs shall be justified.

Audit

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

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

Pre-Visit Letter

21. A-1, page 106 – Be prepared to describe how AIR estimates damage from bypassing storms. Include in the description, examples of storms that reach hurricane strength prior to or

subsequent to causing damage in Florida and are not of hurricane strength when damage is caused in Florida. This was a general issue broached at the March 10-11 Commission meeting.

Verified: YES

Professional Team Comments:

Reviewed the definition of an event, the handling of bypassing storms, and multiple landfalls in the model. Reviewed changes in model methods regarding bypassing storms. Reviewed the computer code for implementing the storm catalog generation.

Reviewed the handling of multiple events at a single location.

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

22. A-2, page 107 – Provide any insurance data obtained since the prior review of the model by the FCHLPM.

23. A-2.A, page 107 – Explain the statement that "… in some cases data was made available by construction type and coverage". Include in the description, the methods used to incorporate data that does include construction type and coverage information.

24. A-2, page 107 – Describe methods used to derive and verify coverage B loss costs. Are Coverage B loss costs assumed to be the same as coverage A loss costs? If so, provide justification for this methodology. Include in your description how loss costs are produced for a Masonry home with a frame appurtenant structure.

25. A-2.1, page 107 – Explain the comment that "All hurricanes affecting Florida are assumed to cause damage in Florida within 72 hours of first damage-causing winds in the state of Florida". Describe whether any storms in the historical or the stochastic storm set cause damage subsequent to 72 hours after the first damage-causing winds in the state of Florida.

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

Professional Team Comments:

Reviewed new claims data received from the 2004 storms. Reviewed the modeler's investigations and handling of claims procedures used by insurers.

Reviewed the client data processing procedures for cleaning the data and importing the data into the model.

Reviewed correspondence between AIR and client regarding the claims data for verification of assumptions.

Reviewed the process of review, actual loss data, correspondence, exposure data, and details on structures within insurance company files.

Reviewed format by which AIR requests loss data from the client and verified the data is validated in the format received from the client.

Reviewed methodology for producing Coverage B loss costs and the validation process.

Revised response to A-2.1 to be provided to the Commission.

Revised response to A-2.1, page 107 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.

Pre-Visit Letter

26. A-3.C, page 111 – Describe the analyses performed to validate the model output loss costs using insurance company data that may or may not include the effects of demand surge.

Verified: YES

Professional Team Comments:

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

Reviewed demand surge analyses incorporating data from 2004 season.

Reviewed demand surge analyses for previous events. Compared conclusions on demand surge for these events in 2004 storm season.

A-4 User Inputs

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

Audit

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

2. All insurer inputs and assumptions will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the client data processing procedures for criteria that are reviewed with the client prior to processing the 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.

A-5 Logical Relationship to Risk

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

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

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

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

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

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

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

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

Audit

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

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

3. Individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, A-5 and A-6 will be used to assess coverage relationships.

Pre-Visit Letter

30. Form A-1, page 137 – Describe the techniques used to determine that it is reasonable to project Coverage B losses at ten percent of coverage A losses for each of the hypothetical events included in Form A-1. Describe any data and methods used to verify this relationship.

31. Form A-3, page 141 – We would like to examine in more detail the eastern, large ZIP Code in Collier County.

32. Form A-4, page 143 – Be prepared to discuss changes in this form from last year.

33. Form A-4, page 144 – Explain the contribution shown for no-name 8 in 1909. Explain the total contribution shown on Form A-4 in relation to the result shown on Form S-4, page 225.

34. Form A-5, page 145 – Be prepared to discuss changes in this form from last year. Aside from changes from last year, the ZIP Codes included will be discussed.

35. Form A-6, page 149 – What causes the differences in return periods between this year's and last year's submissions for losses in the upper end of the range as shown on Figure 37?

Verified: YES

Professional Team Comments:

Reviewed the relationship of Coverage B to Coverage A losses provided in Form A-1.

Reviewed the results in Form A-3 for Collier County.

Reviewed Forms A-4, A-5, and A-6 versus last year's counterparts and the reasons for differences in several instances.

Reviewed Form A-4 for appropriate consideration of changes to official hurricane set.

A-6 Deductibles and Policy Limits

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

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

Audit

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

Pre-Visit Letter

27. A-6, page 125 – Whether 2004 insurer claim experience is incorporated in the development, testing or verification of the current model version or not, describe the methods used to account for the implementation of multiple deductibles in the insurers' claim payment historical records for policy periods where more than one hurricane caused damage at a single location. Describe how multiple deductible claim experience in the historical record is included in the projection of future loss costs. Describe any differences between the process used to account for "multiple deductibles" in this submission and the process used in prior submissions.

Verified: YES

Professional Team Comments:

Reviewed the handling of deductibles in the model and the potential implementation of the Florida annual deductible in the CLASIC/2 software.

Verified no change in the methodology for handling deductibles and policy limits.

Reviewed the impact of the annual deductible on loss costs based on AIR's industry exposure.

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.

Pre-Visit Letter

28. A-7, page 128 – Provide statistical tests used to determine that the ratio of coverage A to coverage C loss cost relationship between actual and modeled building and contents loss costs as shown on Table 12 is statistically acceptable.

Verified: YES

Professional Team Comments:

Reviewed t-tests comparing the relationship between Coverage C to Coverage A by company for several events and several companies.

Reviewed actual versus simulated Hurricane Georges Coverage A and Coverage C claims for several ZIP Codes.

Verified no change in the methodology for handling contents losses.

A-8 Additional Living Expense (ALE)

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

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

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

Audit

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

damage and its effect on ALE costs.

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

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

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

Professional Team Comments:

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

Figure 31, A-8.C, revised with correct label for vertical axis to be provided to the Commission.

Revised Figure 31, page 129 received and reviewed by the Professional Team.

A-9 Output Ranges*

*(*Significant Revision)*

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

B. All other factors held constant:

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

Audit

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

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

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

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

Pre-Visit Letter

29. A-9, page 135 – Provide an explanation for each of the changes in output ranges referenced. In particular, please elaborate on the changes in the model that led to increases and those that led to decreases. Why did Franklin and Wakulla counties decrease? Why did the others increase by more than 10 per cent?

36. Form A-7, page 155 ff – Color code appears to be opposite from instructions.

37. Form A-7, pages 157, 159 – For zero deductible owners frame, the high loss costs are 4.068 for Santa Rosa, and 1.488 for Escambia. Explain this difference. Also explain the change in the high loss cost for Escambia from last year's submission (3.620) to this year's submission (1.488).

38. Form A-8, page 193 – Be prepared to explain the ALE increases from last year.

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

Professional Team Comments:

Reviewed the changes in the output ranges and the impact of the change in the central pressure distribution on the output ranges.

Reviewed ALE increases from last year.

Response to A-9.2 revised to include update to stochastic catalog, the handling of bypassing storms, and the change to the central pressure distribution.

Revised response to A-9.2, page 134 received and reviewed by the Professional Team.

Revised Output Ranges to be provided to the Commission.

Revised Output Ranges, pages 156-190 received and reviewed by the Professional Team.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

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

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

Pre-Visit Letter

39. S-1, page 195 – We need to examine the updated fits for annual landfall frequency, landfall location, and hurricane intensity based on the 1900-2004 data.

40. S-1, page 197 – Can the track angle change abruptly at landfall?

41. S-1, pages 201-202 – There appears to be 7 historical hurricanes in Figure 45 but 33 in the bottom half of Figure 46. What far field pressure was used for the Cp difference?

45. Form S-1, page 218 – Is a footnote intended for the modeled probability? (see * in submission)

46. Form S-1, page 218 – Be prepared to discuss the changes in the probabilities from last year.

47. Form S-2, page 219 – Be prepared to discuss the changes in this form from last year, in particular the large increases for longer return times.

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

Professional Team Comments:

Reviewed the negative binomial distribution for the US landfall frequency.

Reviewed the 95% confidence intervals for probable maximum loss values provided in Form S-2.

Reviewed Chi-Square tests of the historical versus simulated landfall counts in Florida, Mississippi, Alabama, and Georgia.

Reviewed results of Kolmogorov-Smirnov goodness-of-fit tests for central pressure distribution by segments in Florida.

Reviewed fitted Weibull distribution for central pressure distribution by segments in Florida.

Reviewed empirical cumulative distribution function with fitted Weibull cumulative distribution function for central pressure distribution by segments in Florida.

Reviewed the smoothing technique for hurricane frequency by coastal segment.

Reviewed the methodology for storm tracks and track angle at landfall.

Reviewed the weights for simulated central pressure given to segment Weibull versus regional Weibull.

Response to S-1.2 revised to include updated dates for National Hurricane Center reports for Charley, Gaston, and Ivan.

Revised response to S-1.2, page 198 received and reviewed by the Professional Team.

Form S-1 will be resubmitted to the Commission with an explanation of the modeled probability provided in a footnote.

Revised Form S-1, page 218 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 the sensitivity analyses performed on annual frequency, central pressure, Rmax, forward speed, and mean damage.

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.

Pre-Visit Letter

42. S-3.1, page 207 – What conversion factors are used in the code that produces output ranges?

Verified: YES

Professional Team Comments:

Reviewed the uncertainty analysis performed on annual frequency, central pressure, Rmax, forward speed, and mean damage.

S-4 County Level Aggregation*

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

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

Audit

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

Pre-Visit Letter

43. S-4, page 210 – Justify the sample size of 50,000.

Verified: YES

Professional Team Comments:

Reviewed the process and results of the sampling of the stochastic storm set using 50,000 years.

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.

Pre-Visit Letter

44. S-5, page 212 – We would like to examine the unscaled numbers.

Verified: YES

Professional Team Comments:

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

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-4 will be reviewed.

2. Justify the following:
   a. Meteorological parameters,
   b. The effect of bypassing 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*

*(*Significant Revision)*

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

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

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

Audit

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

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

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

4. Modeler personnel, or their designated proxies, responsible for each aspect of the software (i.e. user interface, quality assurance, engineering, actuarial) shall be present when the Computer Standards are being audited. Internal users of the software will be interviewed.

5. Provide verification that documentation is created separately from the source code.

Verified: YES

Professional Team Comments:

Reviewed the primary document binder containing:

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

Reviewed documentation for the ZIP Code re-mapping procedure.

Reviewed documentation for procedure to include bypassing storms in stochastic set for Florida.

C-2 Requirements*

*(*Significant Revision)*

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the requirements binder containing:

- Requirements summary for data sources, analysis engine, user interface, hardware, software, and security requirements
- System requirements
- Software requirements
- ZIP Code mapping requirements
- Catalog generation code requirements
- Physical properties requirements
- Loss estimation software code requirements
- Fortran code requirements and data files for catalog generation
- Fortran data files for generating US physical properties
- Re-mapping of invalid ZIP Codes software requirements

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.

Verified: YES

Professional Team Comments:

Reviewed subroutine for handling of bypassing storms in the model from flowcharts and code description.

Reviewed flow chart and catalog generation code documentation.

Reviewed model architecture and component design documentation.

Reviewed flow chart for the ZIP Code re-mapping algorithm.

C-4 Implementation*

*(*Significant Revision)*

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

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

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

D. The modeler shall maintain a table of all software components affecting loss costs, with the following table columns: (1) Component name, (2) Number of lines of code, minus blank and comment lines; and (3) Number of comment lines.

E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

Audit

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

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

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

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

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

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

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

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

Verified: YES

Professional Team Comments:

Reviewed code comments and documentation for the bypassing storm and ZIP Code re-mapping subroutines.

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

Reviewed documentation on data file structures for the ZIP Code database.

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
- Documentation for the classes implemented in the 2004 updates to the hurricane model
- Data files for the hurricane model documentation
- Software engine and model documentation
- Line count statistics table for ZIP Code re-mapping, bypassing storm code, and user interface code

Reviewed the web-based approach used to automatically document C++ class structures.

Reviewed coding guidelines for the Fortran and C++ code.

C-5 Verification*

*(*Significant Revision)*

A. General

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

B. Component Testing

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

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

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

4. Aggregation tests shall be performed and documented to ensure the correctness of all components, defining the model.

C. Data Testing

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

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

Audit

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

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

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed.

Pre-Visit Letter

48. C-5, pages 231-232 – Be prepared to show detailed unit test documentation for testing on each model component, including all aspects of the model (meteorology, actuarial, vulnerability, statistics, user interface, and other components).

Verified: YES

Professional Team Comments:

Reviewed catalog generation code testing procedure and documentation.

Reviewed process and documentation for software verification and validation.

Reviewed QA test cases and final QA test plan for user interface code.

Reviewed unit tests regarding the modified bypassing storm distance-to-land code.

Reviewed the verification process for re-mapping of population-weighted ZIP Codes.

Reviewed the client data processing procedure for the integrity and consistency of data.

Reviewed regression test procedures for incremental builds of the code.

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.

Verified: YES

Professional Team Comments:

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

Reviewed the policy for model revisions.

C-7 Security*

*(*Significant Revision)*

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

Audit

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

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

Verified: YES

Professional Team Comments:

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