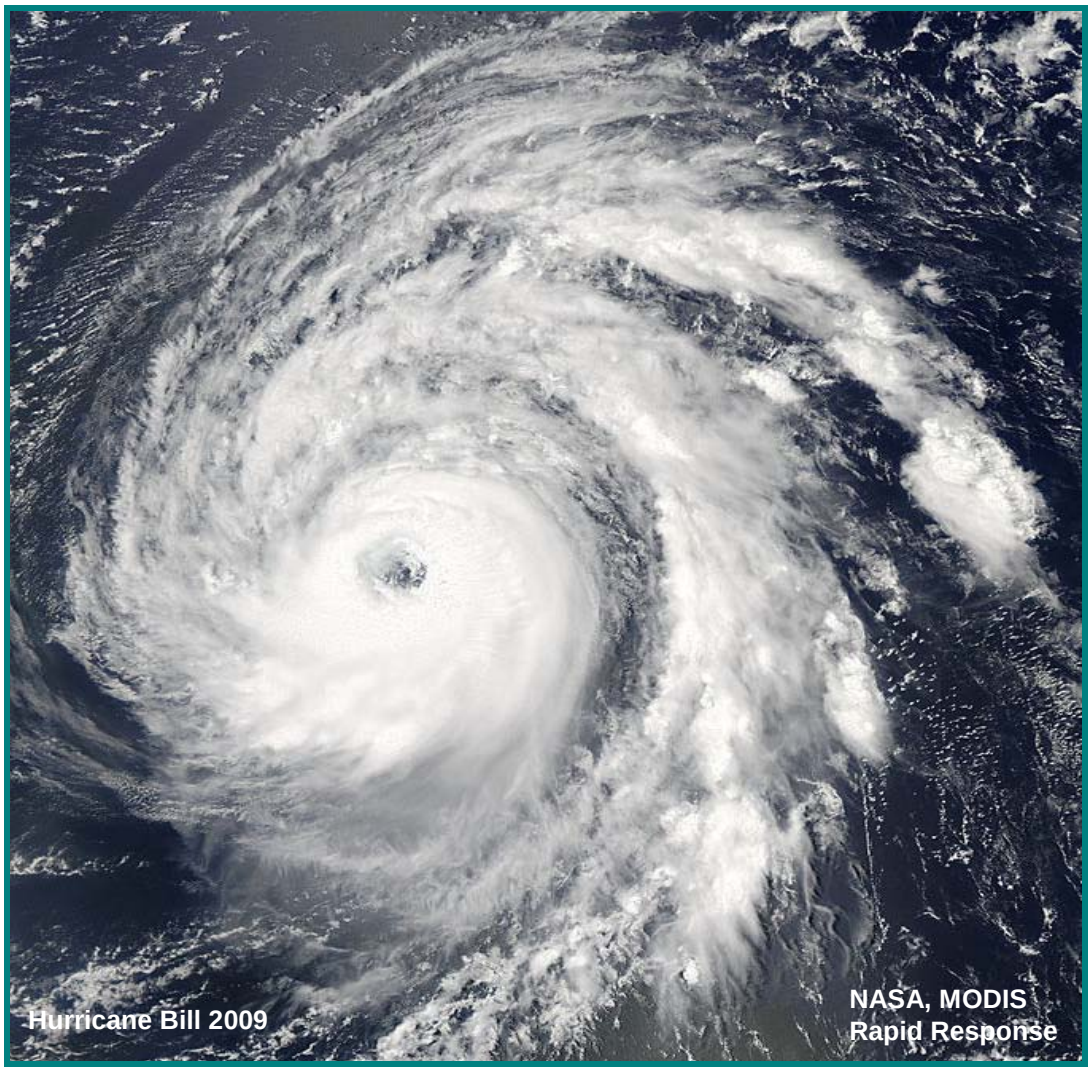
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2009 Standards

AIR Worldwide Corporation

On-Site Review
May 4-7, 2010

On May 4-7, 2010, the Professional Team visited on-site at AIR Worldwide Corporation (AIR) in Boston, Massachusetts. The following individuals participated in the review:

AIR
Brandie Andrews, Risk Consultant
Laxmi Balcha, Senior Database Architect
Tanya Bedore, Technical Writer
Jason Butke, Research Scientist/Meteorologist
Peter Dailey, Ph.D., Assistant Vice President, Director Atmospheric Science, Research and Modeling
Ioana Dima, Ph.D., Senior Scientist Atmospheric Science, Research and Modeling
Tim Doggett, Ph.D., Principal Scientist Atmospheric Science, Research and Modeling
Carol Friedland, Ph.D., P.E., Consultant (via phone)
Jayanta Guin, Ph.D., Senior Vice President, Research and Modeling
Anthony Hanson, Principal Analyst
Cheryl Hayes, Manager Exposures Group, Research and Modeling
Vineet Jain, Ph.D., Principal Engineer, Research and Modeling
Todd Keller, Analyst, Research and Modeling
Shiraj Khan, Ph.D., Senior Engineer, Research and Modeling
Ellen Langhans, Communications Specialist
David Lalonde, FCAS, FCIA, MAAA, Senior Vice President
S. Ming Lee, President and CEO
Guillermo Leiva, Senior Engineer, Research and Modeling
Marc Levitan, Ph.D., Consultant (via phone)
Greta Ljung, Ph.D., Principal Scientist, Research and Modeling
Mary Louie, Ph.D., Senior Scientist, Research and Modeling
Stuart Miller, Ph.D., ARe, Senior Risk Consultant
Sudhir Potharaju, Software Engineering Director & Assistant Vice President
Glenn Rivard, Software Engineer
John Rowe, Director Research Operations, Research and Modeling
Scott Stransky, Scientist, Research and Modeling
Brian Zachry, Ph.D., Scientist Atmospheric Science, Research and Modeling

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

The review began with introductions and an overview of the audit process. AIR provided a general overview of the enhancements to the meteorological and vulnerability model components incorporating new data and more recent research findings. AIR contended that due to the greatly refined windfield the model should be viewed as a new model and that comparisons to the previously accepted model would not be realistic.

Some of the new attributes in the version 12 model highlighted by AIR were:

- Surface roughness due to the new USGS land use and land cover data and the influence of wave action,
- Evolution of Rmax based on high-resolution radar data,
- Windspeed validation due to availability of robust validation data,
- Rmax vertical slant and validation with height,
- Regional damage functions (for underspecified structure types) based on regional inventory distributions,
- Impact of individual risk features,
- Relationship between building and time element damage functions,
- Renters and condos relationships between building and contents damage functions,
- Explicit modeling of the evolution of building codes and their enforcements.

AIR stated that the industry loss changes at the county level are small; however, regional and local changes are more significant. Overall, coastal windspeeds are reduced and inland windspeeds are increased; personal residential vulnerability is stable and commercial residential vulnerability is increased. They indicated changes across all regions, all lines of business, and all building types were reconciled to the specific model updates. Summary of average annual zero deductible statewide loss costs for each model component change are, as follows:

- Event generation module - 3.67%
- Windfield model -14.72%
- Damage functions +25.91%
- ZIP Code database + 0.18%
- Total + 4.08%

The Professional Team reviewed the following corrections to be included in the revised submission to be provided to the Commission no later than 10 days prior to the June 8, 2010 meeting.

1. Page 21, G-1.3, acronyms in flowchart defined
2. Page 22, G-1.4, meteorological references updated for treatment of roughness lengths
3. Pages 30-33, G-1.5, Figures 4-7 revised, figure provided for ZIP Code update percent changes
4. Page 66, M-2.3, location specific parameters clarified
5. Page 68, M-2.4, how peripheral pressure adjustment is used
6. Page 73, M-3.1, statement on no assumptions, reference to Form S-3 added
7. Page 75, M4.B, references added
8. Pages 75-76, M-4.1 & 2, titles for Figures 10 & 11 revised
9. Page 77, M-4.3, flight level and peak weighting factor information added
10. Page 83, M-5.D, Figure 14 revised
11. Page 84, M-5.3, consistent terminology for average distance
12. Page 88, Form M-1, revised Figure 15
13. Page 110, V-2.A, assumptions provided
14. Page 111, V-2.2, statement on mitigation measures in Table 7 modified
15. Page 112, V-2.3, components and weighting clarified
16. Page 113, V-2.4, weighting clarified
17. Pages 115-116, Form V-1 revised
18. Page 121, Form V-2, clarify Table 8 applies to the reference structure in Form V-2
19. Page 163, Form A-1, correct references for FormA1Input09.xls

20. Pages 166-168, Form A-2 maps revised to show invalid ZIP Codes as n/a and footnoted
21. Page 174, Form A-4 corrected
22. Page 185, Form A-5 corrected
23. Page 318, S-1.6, clarify for all US landfall hurricanes
24. Page 329, S-5.1, table titles revised
25. Page 336, Form S-2 corrected
26. Page 349, Form S-5, clarify differences in data sets for percentage change in loss costs from previous submission to those provided in G-1.5
27. Page 350, Form S-5.E and G revised

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the April 15, 2010 meeting. The deficiencies were corrected within the established time frame and the corrections have been verified.

1. Standard G-1, Disclosure 5 (page 29)
   Responses are not provided separately for parts A, B, and C.

2. Standard G-3, Disclosure 1 (page 50)
   Response is incomplete since the ZIP Code databases used by the model are not listed.

3. Standard M-2, Disclosure 5 (page 68)
   Response is incomplete since more information on the process for converting the modeled vortex winds to surface winds including the treatment of the inherent uncertainties in the conversion factor with respect to location of the site compared to the radius of maximum winds over time, and justification for the variation in the surface winds conversion factor as a function of hurricane intensity and distance from the hurricane center are not addressed.

4. Standard M-3, Part A (page 72)
   Landfall location and peak weighting factor are listed as random variables in Standard M-2, Disclosure 3; therefore, the probability distributions for these variables should be discussed in Standard M-3, Part A.

5. Standard M-4, Disclosure 3 (page 77)
   Table is not numbered or listed in the Table of Contents.

6. Standard V-2, Part B (page 110)
   Material provided is non-responsive. Summary response delineating what part of *Attachment F* corresponds to this standard is required.

7. Standard A-2, Part B (page 127)
   Response is incomplete since (3) claim payment practices, (5) contractual provisions, and (6) relevant underwriting practices underlying those losses are not addressed.

8. Standard A-9, Disclosure 3 (page 155)
   Response is incomplete since it does not address consideration of damage to local and regional infrastructure.

9. Form A-3 (pages 169-173)
   Storm ID numbers provided for "Other hurricanes included" do not follow instructions as given in Part B.

10. Form A-4 (pages 174-184)
    Column headings are not shown and repeated at the top of all subsequent pages.

11. Form A-5 (pages 185-236)
    Column headings are not shown and repeated at the top of all subsequent pages.

12. Form S-4 (page 343)
    Response is not provided for Part B.

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

Some of this material may have been shown or may have been available on a previous visit by the Professional Team. The Professional Team will also be considering material in response to the Commission's designation(s) of deficiencies and issues.

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

It is important that all material prepared for presentation during the on-site review, be presented using a medium that is readable by all members of the Professional Team simultaneously. The

Professional Team will review selected computer code in conjunction with the reviews performed for each section. Computer code should be available in a format that will allow simultaneous visualization by the entire Professional Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Professional Team. The Professional Team should be provided access to an internet connection through one of the Professional Team member computers for reference work that may be required while on-site.

The presentation during the on-site review is recommended to proceed in the following sequence: (1) new, or updated, material related to the model; (2) responses to the pre-visit letter questions and issues; and (3) responses to the audit items for each standard in the Report of Activities.

Provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and 2005 hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.
Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2007 FHCF exposure data.

When the Professional Team arrives on-site, provide five (5) printed copies of all figures with scales for the *X* and *Y* axes labeled that are not so labeled in the submission. Label the figures with the same figure number as given in the submission. Also provide five (5) printed copies of Form V-3 and the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

Provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2006. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

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

GENERAL STANDARDS – Mark Johnson, Leader

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

*(*Significant Revision)*

The computer model shall project loss costs and probable maximum loss levels for residential property insured damage from hurricane events.

Audit

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

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

3. Maps, databases, or data files relevant to the modeling organization's submission will be reviewed.

Trade Secret Information to be presented to the Professional Team (page 8):

- G-1 – Computer model code, databases and files relevant to the submission.

Pre-Visit Letter

1. G-1, Disclosure 2, page 18: Discuss definition and treatment of bypassing storms. (Commission issue)

2. G-1, Disclosure 2, page 18: Discuss the use of 100-nautical-mile segments for central pressure and forward speed and the use of 50-nautical-mile segments for storm heading at landfall probability distributions. (Commission issue)

3. G-1, Disclosure 2, page 19: Provide a detailed description of the Gradient Wind Reduction Factor (GWRF) and Peak Weighting Factor (PWF) described in this section. Be prepared to review the GWRF and PWF fits in detail and the updates to the other distributions that were fit.

4. G-1, Disclosure 3, page 21: Figure 3 has been modified from the previous submission. Explain how "More hours?" comes into play. Explain how this flow altered the source code. Define Cp, Rmax, Vt, and A used in the flowchart.

5. G-1, Disclosure 5, page 29: Provide scientifically rigorous and detailed explanations of how the four major model changes result in the corresponding percentage changes in losses.

6. G-1, Disclosure 5, page 29: For the Event Generation Module, provide details relating to the following individual effects as part of the cited 3.67% decrease:
    a. Landfall location now continuous. Explain the metric used in defining a continuous landfall location.
    b. Updated models for Rmax, forward speed, and landfall angle.

7. G-1, Disclosure 5, page 29: For the Windfield Model, provide details relating to the cited 14.80% decrease.

8. G-1, Disclosure 5, page 29: For the Event Generation Module and the Windfield Model, provide comparison with the previous submission of the model tracks and storm characteristics contributing to the net 18.47% decrease attributed to the meteorology component of the model.

9. G-1, Disclosure 5, page 29: For Damage Functions, provide details relating to the following individual effects as part of the cited 25.91% increase from:
    a. Vulnerability relationships updated in light of new damage data.
    b. Regional and temporal vulnerability modifiers, including the effect of secondary risk features, reviewed and significantly enhanced.

10. G-1, Disclosure 5, page 29: For ZIP Code Database Update, describe the effects of individual ZIP Code changes.

11. G-1, Disclosure 5, page 29: Explain the value 4.41% versus the values in Form S-5.

12. G-1, Disclosure 5, pages 30-33: Correct the lower end of the legends on Figures 4-7.

13. G-1, Disclosure 5, page 30: Discuss the spatial distribution of changes as presented in Figure 4 relating to the Event Generation component of the model with reference to Form M-1.

14. G-1, Disclosure 5, page 31: Discuss the changes as presented in Figure 5 relating to the Windfield percentage impacts for the following counties:
    a. Monroe versus Miami-Dade
    b. Monroe versus Collier versus Lee
    c. Wakulla

15. G-1, Disclosure 5, page 32: Discuss the changes as presented in Figure 6 relating to the Damage Function percentage impacts for the following counties:
    a. Monroe
    b. Miami-Dade
    c. Indian River
    d. Walton
    e. Holmes
    f. Washington

16. G-1, Disclosure 5, page 33: Explain why the county boundaries for Figure 7 are different from those for Figures 4-6 and from Figure 2 in the Report of Activities; e.g., Santa Rosa, Okaloosa, and Walton.

Verified: YES

Professional Team Comments:

Technical papers were provided for on-site review.

Reviewed computer code related to the Gradient Wind Reduction Factor (GWRF) and the Peak Weighting Factor (PWF).

Reviewed supporting databases for GWRF and PWF.

Discussed the use of 100-nautical-mile segments for central pressure and forward speed and the use of 50-nautical mile segments for storm heading and landfall probability distributions during the review of the Meteorological Standards.

Discussed in detail the GWRF and PWF during the review of the Meteorological Standards.

Discussed the flowchart of the interactions among major model components provided in Figure 3. Reviewed updated Figure 3 defining the acronyms Cp, Rmax, Vt, and A.

Reviewed the ZIP Code database update by examining maps of Florida with old and new centroids. One specific centroid was identified that required additional explanation.

Discussed differences resulting from the use of different exposure data sets to produce the percentage changes in average loss costs given in Disclosure 5 and the percentage changes given in Form S-5.

Noted that the revised Figures 4-8 reflect an adjustment to the base comparison set with respect to ZIP Codes. Additional figure provided information on impact of ZIP Code changes alone.

G-2 Qualifications of Modeling Organization Personnel and Consultants

A. Model construction, testing, and evaluation shall be performed by modeling organization personnel or consultants who possess the necessary skills, formal education, and experience to develop the relevant components for hurricane loss projection methodologies.

B. The model or any modifications to an accepted model shall be reviewed by either modeling organization personnel or consultants in the following professional disciplines: structural/wind engineering (licensed Professional Engineer), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall 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 modeling organization personnel and consultants responsible for the current model and information on their predecessors if different than current personnel will be reviewed. Background information on individuals providing testimonial letters in the submission shall be provided.

2. Forms G-1, G-2, G-3, G-4, G-5, G-6, and all independent peer reviews of the model under consideration will be reviewed. Signatories on the individual Forms will be required to provide a description of their review process.

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

Pre-Visit Letter

17. G-2, Disclosure 1.A, page 35: Describe the involvement of the Insurance Services Office in the development, validation, or marketing of the model under consideration in this review.

18. G-2, Disclosure 2.A, pages 37-46: Discuss departures of personnel involved in the previous version of the model.

19. G-2, Disclosure 2.B, page 46: Provide the resumes of the new employees working on the model or acceptability process who were not involved at the time of the previous Professional Team review:
    a. Guillermo Leiva, Vulnerability
    b. Shiraj Khan, Vulnerability
    c. Connie Kang, Actuarial

d. Donald Alcombright, Computer Science
e. Laxmi Balcha, Computer Science
f. Michael Crouch, Computer Science
g. Glenn Rivard, Computer Science
h. Anthony Hanson, Computer Science

20. G-2, Disclosure 3, page 48: Provide the review reports of Drs. Emanuel, Black, and Contreras, and Mr. Rollins.

Verified: YES

Professional Team Comments:

Discussed changes in personnel and personnel responsibilities involved in the modeling process. No departures of personnel attributable to ethical violations.

Reviewed resumes of new personnel:

- Donald Alcombright, B.S. Information Technology, Daniel Webster College, Nashua, NH
- Brandie Andrews, B.S. Mathematics, Wheaton College, Wheaton, IL
- Laxmi Balcha, M.S. Software Engineering, Brandeis University, India; B.S. Electronics & Communications Engineering, Osmania University, India; B.S. Commerce
- Michael Crouch, B.S. Technical, Scientific, and Professional Communication, Worcester Polytechnic Institute, Worcester, MA
- Anthony Hanson, M.A. Economics, Boston College
- Connie Kang, M.S. Statistics, Columbia University, New York, NY; B.S. Business Administration, Jin Nan University, China
- Shiraj Khan, Ph.D., Civil Engineering, University of South Florida, Tampa; Ph.D. Civil Engineering, Carnegie Mellon University, Pittsburgh, PA; B. Tech Civil Engineering, Indian Institute of Technology, Roorkee, India
- Guillermo Leiva, Structural and Civil Engineering, Pontificia Catholic University of Chile; M.S. Mathematics, Carnegie Mellon University, Pittsburgh, PA
- Glenn Rivard, B.S. Mechanical Engineering, University of Hartford, Hartford, CT

Determined that there was no involvement of the Insurance Services Office (ISO) in the development or validation of the model other than the use of ISO data in validation.

Reviewed the peer review reports of Dr. Kerry Emanuel, Dr. Peter Black, Dr. Robert Contreras and John Rollins. Reviewed additional email correspondence with Drs. Emanuel and Black.

G-3 Risk Location

A. ZIP Codes used in the model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the model. ZIP Code information shall originate from the United States Postal Service.

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

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

Audit

1. Provide geographic displays for all ZIP Codes.

2. Provide geographic comparisons of previous to current locations of ZIP Code centroids.

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

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

Pre-Visit Letter

21. G-3, page 50: Be prepared to review the updated ZIP Code centroids as has been done during previous on-site reviews.

Trade Secret Information to be presented to the Professional Team (page 8):

- G-3 – Visual representation of the reasonableness of the population-weighted ZIP Code centroids, ZIP Code validation and update process document

Verified: YES

Professional Team Comments:

Reviewed the process for updating and validating the population-weighted centroids.

Reviewed geographic displays of ZIP Codes and comparisons of new centroid locations to previous locations.

Reviewed histogram of ZIP Code centroid movement and map of the top ten centroid movements in 2009.

Reviewed table of centroid movements greater than 1 mile with their plots of the ZIP Code boundary and centroid changes.

G-4 Independence of Model Components

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

Audit

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

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

Pre-Visit Letter

22. G-4, page 52: Demonstrate the independence of model components, in lieu of significant reductions due to Event Generation and Windfield modifications as opposed to the significant increase due to Damage Functions modifications.

Verified: YES

Professional Team Comments:

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

G-5 Editorial Compliance

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

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2009*.

2. Describe all changes to the submission document since the previously accepted submission that might impact the final document submission.

3. Demonstrate that the submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and inclusion of extraneous data or materials.

4. Demonstrate that the submission has been reviewed by the signatories on Forms G-1 through G-6 for accuracy and completeness.

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

6. A flowchart defining the process for form creation will be reviewed.

7. Form G-7 will be reviewed.

Verified: YES

Professional Team Comments:

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

Discussed with Ellen Langhans her process for editorial review. Discussed the submission documentation modification history and document revision control.

Reviewed flowchart for completion of submission forms.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 7, 2009 (or later). Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

B. Any trends, weighting, or partitioning shall be justified and consistent with currently accepted scientific literature and statistical techniques. Calibration and validation shall encompass the complete Base Hurricane Storm Set as well as any partitions.

Audit

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

2. Provide a flowchart illustrating how changes in the HURDAT database are used in the calculation of landfall distribution.

3. Reasoning and justification underlying any modification by the modeling organization to the Base Hurricane Storm Set will be reviewed.

4. Reasoning and justification underlying any short-term and long-term variations in annual hurricane frequencies incorporated in the model will be reviewed. (Trade Secret List item)

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

6. Form M-1 will be reviewed for consistency with Form S-1. Changes to the modeling organization's Base Hurricane Storm Set from the previously accepted submission will be reviewed.

7. Comparisons of modeled probabilities and characteristics from the complete historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against the complete historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

Pre-Visit Letter

23. M-1, page 63: Variations to HURDAT will be reviewed.

24. M-1, Disclosure 2, page 64: Describe the "minor modifications" to HURDAT database.

51. Form M-1, page 87: Discuss the intensity distributions in each region. Numbers reported in this form should be scaled to match the period of the historical record used.

Trade Secret Information to be presented to the Professional Team (page 8):

- M-1 – Updates to the historical storm set

Verified: YES

Professional Team Comments:

Reviewed updates to the historical storm set using the latest HURDAT as of June 1, 2009. Verified no additional Florida landfalls since previous submission.

Reviewed flowchart documenting the method of including changes in the modeler historical storm set. Verified no change in methodology for incorporating the additional data since the previously accepted methodology. Discussed use of this methodology for inclusion of changes referred to below.

Discussed the variations to HURDAT that were modifications to 6-hourly points as well as the incorporation of NOAA Technical Memorandum NWS TPC-5 landfall central pressure data. Reviewed modification of Hurricane Abby (1968) central pressure and discussed correspondence with Dr. Chris Landsea, National Hurricane Center, on the modification.

Verified that no partitioning was used in developing the historical landfall frequencies.

Reviewed chi-square goodness-of-fit test of modeled to historical hurricane frequencies.

Discussed basis for differences in historical frequencies by category in Figure 9, Historical Hurricane Frequency by Coastal Segment and Figure 15, Historical Hurricane Frequency for Florida and Neighboring States by Region. These included differing ranges for coastal segments and the use of Cp for Figure 9 and Vmax for Figure 15 in partitioning at landfall.

Reviewed comparisons of modeled probability distributions for intensity and frequency. Methodology for determining these distributions is unchanged from previously accepted methodology.

Reviewed consistency between Forms M-1 and S-1.

Reviewed the list provided by modeler of modifications to HURDAT. Discussed with modeler the reasoning underlying these changes near landfall and their correspondence to HURDAT or the NOAA report (TPC-5) for selected hurricane events.

Confirmed that NoName 3 (1911) and Ethel (1960) are included in modeler Base Hurricane Storm Set (related to Form A-3).

Discussed modeler definition of by-passing hurricanes (details under Standard A-1). Discussed consistency between the definition of "by-passing" implemented when compiling historical and stochastic storm statistics in completing Form M-1.

Reviewed revised Figure 15 with Table 3 (Form M-1). Discussed relativities in distributions across regions.

M-2 Hurricane Parameters and Characteristics*

*(*Significant Revision)*

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

Audit

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

2. Prepare graphical depictions of hurricane parameters as used in the model. Describe and justify:

   - The data set basis for the fitted distributions,
   - The modeled dependencies among correlated parameters in the windfield component and how they are represented,
   - The asymmetric nature of hurricanes,
   - The fitting methods used and any smoothing techniques employed.

3. The treatment of the inherent uncertainty in the conversion factor used to convert the modeled vortex winds to surface winds will be reviewed and compared with currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location within the windfield for a given hurricane intensity will be reviewed.

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

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

6. Describe the value(s) of the far-field pressure used in the model and approximate its sensitivity on the average annual zero deductible statewide loss costs.

Pre-Visit Letter

25. M-2, Disclosure 1, page 65: Describe the basis, data used, and method for peripheral pressure adjustment.

26. M-2, Disclosure 1, page 65: Explain why the hurricane parameters listed under Disclosure 1 do not include variables air density coefficient, Coriolis parameter, peripheral pressure, and filling rate listed under Disclosure 2.

27. M-2, Disclosures 1 & 2, page 65: Provide sources of data and if and how the parameters, such as GWRF, PWF, peripheral pressure, Coriolis parameter, and air density coefficient are set for historical storms in the model.

28. M-2, Disclosure 3, page 66: Discuss "the probability distribution for radius of maximum winds modeled using a regression model…," and "the error term assumed to be normally distributed." (Commission issue)

29. M-2, Disclosure 3, page 67: Describe the development of the GWRF and the PWF and justify their inter-relationship in the model.

Trade Secret Information to be presented to the Professional Team (page 8):

- M-2 – Methods for depicting all modeled hurricane characteristics and goodness-of-fit tests. Comparison of observed and modeled hurricane parameters and wind speeds.

Verified: YES

Professional Team Comments:

Reviewed methodology and data used for the peripheral pressure adjustment for historical hurricanes. Discussed that peripheral pressure adjustment is not incorporated in the stochastic storm set.

Discussed the landfall distributions on the base storm set derived from HURDAT and supplementary data sources.

Verified no change in smoothing methods from previous submission.

Discussed that the treatment of the asymmetry due to storm motion is unchanged from previously accepted methodology.

Discussed air density coefficient, Coriolis parameter, and peripheral pressure are latitudinally-dependent input parameters (not distributions). Discussed filling rate being location dependent.

Reviewed use of Peak Weighting Factor (PWF) in computations for the surface maximum windspeed.

Reviewed combination of Gradient Wind Reduction Factor (GWRF) and PWF in representation of generally observed Rmax increase with height. Discussed the inherent uncertainty in conversion of winds at gradient level to the surface. Discussed the development of the GWRF and the PWF and the motivation for making these stochastic parameters. Reviewed scatter plots of the GWRF versus distance from eyewall.

Reviewed distributions for the GWRF and the PWF. Reviewed scatter plot of GWRF and PWF showing their dependence.

Reviewed Shapiro-Wilk goodness-of-fit tests for the GWRF and the transformed PWF. Discussed the treatment of uncertainty in the mean GWRF with the standard deviation consistent with Powell et al. (2009) and Franklin et al. (2003).

Reviewed additional references and their relevance to aspects of the model windfield generation. Additional references incorporated into Standard G-1, Disclosure 1.

Discussed the impact of far-field (peripheral) pressure on loss costs and the dependence of peripheral pressure on latitude.

Discussed determination of peripheral pressure for individual historical storms.

Discussed formulation of Rmax distribution and inclusion of error term.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

B. Modeled hurricane landfall strike probabilities shall reflect the Base Hurricane Storm Set used for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).

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

Saffir-Simpson Hurricane Scale:

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

Audit

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

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

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

4. Provide any modeling organization specific research performed to develop the functions used for simulating model variables or to develop databases.

5. Form S-3 will be reviewed for the probability distributions and data sources.

Pre-Visit Letter

30. M-3, page 72: Distributions of historical and modeled hurricane parameters and characteristics will be reviewed.

31. M-3.A, page 72: Provide the weights applied and discuss their appropriateness for the mixture of regional Weibulls and segment Weibull for the intensity distribution used for each 100-nautical-mile coastal segment. (Commission issue)

32. M-3, Disclosure 1, page 74: Provide the time period used for each database in Table 2.

33. M-3, Disclosure 1, page 74: Provide a list of all assumptions.

Verified: YES

Professional Team Comments:

Reviewed modeled versus historical landfall frequencies by 50-mile coastal segments and the smoothing weights applied. Verified no change in the methodology used to generate stochastic storm tracks since the previously accepted methodology. Discussed comparable quality of fit for adjacent states.

Discussed update to stochastic strike locations, now being selected from a continuous uniform distribution within each 50-nautical mile segment.

Discussed the addition of the Florida Key segment for updating landfall frequencies.

Discussed the correlation between Central Pressure and Rmax. Discussed the probability distribution for Rmax incorporated using a regression model. Verified no change in the methodology from the previously accepted methodology.

Reviewed histogram of Rmax for historical and simulated storms. Reviewed scatter plot of Rmax and Central Pressure.

Reviewed Form S-3 and discussed dataset detail provided in response to Standard M-3.

Reviewed AIR specific research used to develop the functions for simulating model variables and to develop databases.

Reviewed probability distributions updated for all relevant model parameters. Reviewed comparison of historical and simulated central pressure distributions for several Florida segments.

Reviewed Shapiro-Wilk goodness-of-fit tests for forward speed at landfall.

Discussed development of segment distributions of intensity for 100-nautical-mile coastal segments using a Weibull distribution. Discussed the fitting of regional distributions.

Reviewed the smoothing weights applied for Florida segments and adjacent regions. Reviewed map of 100-mile coastal segments.

Reviewed Kolmogorov-Smirnov goodness-of-fit tests for modeled central pressure distributions.

Reviewed the time periods used for each primary database listed in Table 2. Response revised.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

A. Windfields generated by the model shall be consistent with observed historical storms affecting Florida.

B. The translation of land use and land cover or other source information into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.

C. With respect to multi-story structures, the model windfield shall account for the effects of the vertical variation of winds if not accounted for in the vulnerability functions.

Audit

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

2. Provide any modeling organization-specific research performed to derive the roughness distributions for Florida and adjacent states.

3. The spatial distribution of surface roughness used in the model will be reviewed.

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

5. Provide detailed comparisons of the model windfield with Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005).

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

7. The effects of vertical variation of winds as used in the model where applicable will be reviewed. (Trade Secret List item)

8. Form M-2 will be reviewed.

Pre-Visit Letter

34. M-4.B, page 75: Provide reference for the treatment of roughness lengths and justify its currency.

35. M-4.C, page 75: Elaborate on the response regarding treatment of winds through the depth of the boundary layer with reference to the Standard M-4, Disclosure 4 response.

36. M-4, Disclosure 1, page 75: Provide justification for the symmetric gradient wind profile used in the model. Discussion should include reference to historical storm profiles and consideration of vortex stability. (Commission issue)

37. M-4, Disclosure 2, page 76: Provide symmetric gradient wind profiles, method for determining hurricane parameters for historical storms, and supporting data for the seven 2004 and 2005 hurricanes. Provide comparisons similar to Figure 11 for other pairs of central pressure and Rmax, but same latitude.

38. M-4, Disclosure 3, page 77: Provide information on the PWF equivalent to that provided in the table for the other model windfield parameters.

39. M-4, Disclosure 3, page 77: Define Z_o as applied to Friction Factor.

40. M-4, Disclosure 3, page 77: Provide the wind formulation validation for the 36 US storms.

41. M-4, Disclosure 6, page 78: Discuss choice and application of averaging distance in the model.

42. M-4, Disclosure 8, page 78: Provide information on the resampling methodology, including the choice of area for gust factor and for friction factor.

43. M-4, Disclosure 9, page 79: Provide detailed comparisons of the historical and modeled spatially-varying windfields and scatter plots for the seven 2004 and 2005 hurricanes.

44. M-4, Disclosure 10, page 80: Provide if and how the uncertainty in the windfield model for a given historical or simulated hurricane, as depicted in Figure 13, is captured by the model in loss calculations, and if it is not captured, provide justification.

45. M-4, Disclosure 12, page 81: Discuss the treatment of open terrain and over water in relation to the results presented in Form M-2.

52. Form M-2, page 91: Explain the pink region in south central Polk County, just north of the Hardee-Highlands border in Figure 17.

53. Form M-2, page 91: Provide the storm which caused the maximum windspeed and actual and open terrain roughness factors for Figure 17.

54. Form M-2, page 91: Discuss the treatment of terrain for locations in the Florida Keys.

55. Form M-2, page 92: Explain on Figure 18 why in general 100-year windspeeds are higher in Open Terrain versus Actual Terrain, yet the maximum windspeed is the other way around. Explain why the location of maximum winds differs for Actual Terrain and Open Terrain.

56. Form M-2, page 93: Explain on Figure 19 why in general 250-year windspeeds are higher in Open Terrain versus Actual Terrain, yet the maximum windspeed is the other way around. Explain why the location of maximum winds differs for Actual Terrain and Open Terrain.

57. Form M-2, pages 92-93: Discuss on Figures 18 and 19 why the locations of maximum winds for Actual Terrain differ for 100-year and 250-year.

58. Form M-2.C., page 94: Explain why the windspeeds for "real exposure" are higher than "open exposure." Explain why the maximum winds are all located in the Florida Keys. (Commission issue)

Trade Secret Information to be presented to the Professional Team (page 8):

- M-4 – Documentation of wind speed validation

Verified: YES

Professional Team Comments:

Discussed databases and AIR research used in development of the windfield functions.

Reviewed diagnostics of historical storms used in the development of GWRF and the new PWF. Reviewed modeler analysis of dropsonde data for bringing flight-level winds to surface level.

Discussed the land use and land cover (LULC) database derived from the most recent satellite imagery for the entire United States published by the U.S. Geological Survey. Discussed AIR's quality control of the LULC data using South Florida Water Management District data as well as high resolution elevation data. Reviewed map of the LULC.

Discussed other variables contributing to calculation of location-specific gust factor and friction factor.

Reviewed spatial distribution of modeled windspeeds compared to observations for Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Dennis (2005), Hurricane Katrina (2005) (Florida only) and Hurricane Wilma (2005). Discussed with modeler spatial distributions of differences with reference to storm footprint and new windfield model components.

Reviewed scatter plots for Hurricane Charley (2004), Hurricane Jeanne (2004), Hurricane Katrina (2005), Hurricane Dennis (2005), Hurricane Ivan (2005), and Hurricane Wilma (2005).

Reviewed time-based contour animations for Hurricane Andrew (1992) and Hurricane Wilma (2005).

Discussed impact of vertical variations that are accounted for in the vulnerability functions.

Discussed translation of LULC to roughness length (Z_o) and change in the roughness factor range from the previous submission.

Discussed development of friction and gust factors assuming boundary layer winds follow the log-law profile. Reviewed graph of windspeed versus height.

Reviewed references for the treatment of roughness lengths and discussed their currency.

- Cook 1985
- Simiu and Scanlan 1996
- Grimmond and Oke 1999
- Model lookup tables from RUC and MM5

Discussed implementation of gust factor and friction factor in the model.

Discussed underlying reasoning for application of differing averaging distances for gust factor and friction factor.

Discussed relevance of turbulence intensity and effective Z_o to gust factor.

Reviewed modeler-specific research used to develop updated method for calculating friction factor at a site.

Reviewed maps depicting the spatial distribution of the average surface roughness factors for Florida. Reviewed maps depicting spatial distributions of friction factor.

Discussed the windspeed radial profile used in the model based on the radial variation of upper level winds developed by Willoughby et al. (2006). Reviewed validations against observed data.

Reviewed comparison of rotational windspeed versus distance from center for NWS 23 and Willoughby et al. (2006).

Discussed the application of a location specific Radial Adjustment Factor (RAF) for spatial variability.

Discussed the application of research by Powell et al. (2009) and Franklin et al. (2003) related to the relationship between flight-level and surface wind maxima.

Reviewed the methodology for implementing a spatially-varying gradient to surface wind conversion. Reviewed relationship between GWRF and the new PWF as implemented in the model. Discussed modeler justification for these updates based on recent literature and modeler-specific research.

Reviewed table of surface wind calculation terms. Table revised to include PWF.

Discussed uncertainty in the windfield. Reviewed mean damage ratio comparisons of actual versus simulated, damage from claims information versus the model distribution.

Reviewed scatter plot of wind formulation validation for the 36 US storms.
Reviewed symmetric gradient wind profile plots for Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Jeanne (2004), Hurricane Dennis (2005), Hurricane Katrina (2005) and Hurricane Wilma (2005).

Reviewed table of hurricane parameter values used in specifying symmetric gradient wind profiles for these hurricanes.

Reviewed implementation of windfield formulation in the model. Discussed vortex stability relative to the hurricane parameters applied to the historical storm examples.

Reviewed Form M-2 with particular consideration of changes in location and peak windspeeds across return periods and surface roughness criteria chosen.

Reviewed spatial distribution of locations with surface roughness at lower bound. Locations identified are all on coast as expected; for example, Ormond Beach, Daytona Beach, Melbourne Beach, Captiva and Long Boat Key.

Discussed the treatment of open terrain and over water windspeeds in Form M-2. Reviewed windspeeds in ZIP Code contours.

Resampling of LULC utilizes commercial software package.

Reviewed equations for implementing new friction factor and gust factor formulations in the code. Reviewed corresponding code during Computer Standards.

Discussed the Labor Day Storm (1935) as the source of the maximum windspeed in Figure 17 of Form M-2.

Discussed the change in locations of the maximum winds in Figures 18 and 19 of Form M-2 due to spatial differences in the frequency and intensity distributions for each location.

Discussed treatment of terrain in the Florida Keys. Discussed changes to the treatment of friction factor over water. Discussed the reason for higher windspeeds for open terrain being related to the new roughness (friction factor) formulation.

Discussed how new friction factor formulation over water contributes to relativities depicted between actual and open terrain for maps in Form M-2.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

A. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records and with current state-of-the-science.

B. The transition of winds from over-water to over-land within the model shall be consistent with current state-of-the-science.

Audit

1. Describe the variation in over-land decay rates used in the model.

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

3. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed. Provide color-coded snapshot maps of roughness length and spatial distribution of windspeeds over-land and over-water for Hurricane Dennis (2005) and Hurricane Andrew (1992) at the closest time after landfall. (Trade Secret List item)

Pre-Visit Letter

46. M-5, Disclosure 1, page 82: Provide information on the determination of C_1 and C_2 and any variations in these.

47. M-5, Disclosure 1, page 83: Provide information on the fraction of events in Florida for which the over-land re-intensification is applied.

48. M-5, Disclosure 2, page 83: Provide information on the preparation of Figure 14. Specifically, are the historical storms simulated or from HURDAT?

49. M-5, Disclosure 3, page 84: Provide information on the determination of averaging radius for each storm or location.

50. M-5, Disclosure 4, page 84: Discuss the variation of the windfield parameters over land and how this affects the spatial distribution of hurricane winds. (Commission issue)

Trade Secret Information to be presented to the Professional Team (page 8):

- M-5 – Documentation of methodology for smoothing landfalls and goodness-of-fit tests. Maps depicting land friction effects. Comparisons of observed and modeled wind speeds showing how winds are spatially distributed.

Verified: YES

Professional Team Comments:

Reviewed the range of model decay rates as a function of landfall intensity and time. For historical storms the 1-hourly track points are derived directly from HURDAT and central pressure is normalized relative to the landfall central pressure.

Reviewed Figure 14 for comparison of modeled decay rates for fast and slow moving storms compared to recent historical landfalls.

Reviewed maps of winds at landfall for the seven 2004 and 2005 hurricane landfalls in Florida. Discussed variation of winds around the coast.

Reviewed maps of spatial distribution of average friction factor and of friction factors applied for a uniform wind over the entire state.

Reviewed maps of Hurricane Andrew (1992) and Hurricane Dennis (2005) directional friction factors applied at hour after landfall and modeled hourly maximum windspeeds.

Discussed the refinement of windspeed calculation at a location through storm passage compared to previous submission.

Discussed averaging radius being the same as averaging distance for adjusting over-water to over-land windspeeds. Response revised.

Discussed the radial variation in GWRF. Discussed the 6-hour phase out of the radial adjustment function starting 3 hours after landfall. Discussed the impact of the reduction on the winds.

Reviewed comparison plots of Rmax relative distance to GWRF adjustment.

Discussed variation of over-land decay rates by geographic area and class of storm intensity.

Discussed changes to Rmax over land and treatment if storm exits back over water.

M-6 Logical Relationships of Hurricane Characteristics

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

B. The mean windspeed shall decrease with increasing surface roughness (friction), all other factors held constant.

Audit

1. Form M-3 and the modeling organization's sensitivity analyses provide the information used in auditing this standard.

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

3. Justify the variation of the asymmetry with the translation speed.

Pre-Visit Letter

59. Form M-3, page 95: Discuss differences in radii between historical data, the current model, and the previous submission.

Trade Secret Information to be presented to the Professional Team (page 8):

- M-6 – Sensitivity analyses

Verified: YES

Professional Team Comments:

Reviewed Form M-3. Discussed radial distributions of windspeed in previous formulation compared to Willoughby et al. (2006) profiles and how these relate to changes in threshold wind radii.

Reviewed comparisons between extended best track historical wind radii (for 40 mph and 73 mph) with the minimum and maximum radii for these windspeeds in the current model and in the previous submission.

Reviewed use of radar data in updating Rmax values for some recent historical storms. Example for Hurricane Ike (2008).

Reviewed scatter plots of Rmax versus Central Pressure for a set of historical storms.

Verified no change from the previously accepted submission in windfield asymmetry applied for a moving storm.

Viewed animations of Hurricane Andrew (1992) and Hurricane Wilma (2005). Discussed differences in asymmetry with storm translation speed.

Reviewed logical relationships in modeler sensitivity and uncertainty analyses in conjunction with review of Statistical Standards S-2 and S-3 (Form S-6).

Reviewed differences between the current and previous submission in the modeled loss costs from Hurricane Andrew (1992) for selected coastal ZIP Codes. Analysis was in conjunction with Actuarial Standard A-6 review (Forms A-4 and A-5). Discussed sources of windspeed differences at these locations including radial variation of winds, choice of storm parameters, adjustments of gradient winds to damaging winds and other factors.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

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

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

C. Building height, construction type, and construction characteristics shall be used in the derivation and application of vulnerability functions.

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

E. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and time element coverages.

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

G. Vulnerability functions shall include damage due to hurricane hazards such as windspeed and wind pressure, water infiltration, and missile impact. Vulnerability functions shall not include explicit damage due to flood, storm surge, or wave action.

Audit

1. Historical data shall be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. To the extent that historical data are used to develop vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete structural calculations shall be presented so that a variety of different structure types and construction characteristics may be selected for review. The basis for expert opinion and original site inspection reports shall be available for review.

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

3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and time element coverages shall be available. The magnitude of logical changes among these items for a given windspeed shall be explained and validation materials shall be available.

4. Justify the construction types and characteristics used.

5. Provide validation of the mean vulnerability functions and associated uncertainties.

6. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement. If age of building is used as a surrogate for building code and code enforcement, provide complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s).

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

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

9. Form V-1 will be reviewed.

Pre-Visit Letter

Provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2006. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Loss data is current up through what year? Does the loss data include Citizens data?

60. V-1, page 98: Verify that the adjustments in the damage functions support the large increase in losses attributable to them.

61. V-1, page 98: Provide samples of vulnerability functions for structure, content, and time element coverages for wood frame, masonry, and mobile home and comparisons with the corresponding functions from the previous submission.

62. V-1.B, page 98: Discuss the development of probability distributions around the mean damage ratios for a given level of windspeed.

63. V-1.C, page 98: Describe how windspeed variation by height is captured in the vulnerability functions. Provide justification that for single-family homes, vulnerability functions do not vary by height.

64. V-1.D, page 99: Provide justification and impact on vulnerability functions for various time periods.

65. V-1, Disclosure 2, page 101: Provide and discuss the additional personal residential loss data as well as commercial residential loss data used to construct/validate the vulnerability functions.

66. V-1, Disclosure 2, pages 102-104: Compare the actual loss data used in the current submission versus the previous submission for Figures 22 to 27.

67. V-1, Disclosure 2, pages 102-103: Discuss Figures 22 to 25 and why for higher windspeeds most of the actual data points are less than the modeled losses.

68. V-1, Disclosure 2, page 104: Provide similar plots for commercial residential exposure.

69. V-1, Disclosure 5, page 106: Provide the 20 different residential construction types (page 98), how they relate to Tables 5 and 6, and their vulnerability functions.

70. V-1, Disclosure 5, page 106: *U.S. Hurricane Individual Risk Methodology*, provided as *Attachment F*, is referenced throughout the submission as the source for modeling secondary characteristics, including regional and temporal code variations. Address the methodology implemented as described in *Attachment F*. Discuss the differences between the data presented in the previous submission and the current submission in Figure 3 on page 447.

74. Form V-1, page 115: Explain why there seems to be a substantial increase in the estimated damage for lower windspeeds and decrease in estimated damage for higher windspeeds relative to the previous submission. Provide a comparison of model produced windspeeds for the two scenario storms for both the current submission and the previous submission at the 335 ZIP Codes and compare with what is provided in the file "FormV1Input09.xls." Explain the discontinuity between the upper and lower bounds in transitioning from one windspeed range to the next. (Commission issue)

Trade Secret Information to be presented to the Professional Team (page 8):

- V-1 – Original client data, samples of vulnerability functions, modifications to the vulnerability functions due to building codes, computer code showing minimum wind speed at which damage occurs, damage survey data

Verified: YES

Professional Team Comments:

Reviewed new insurance loss data through 2005 and new engineering research that has been used to update and validate the vulnerability functions.

Discussed the significant increase in detailed company personal residential claims data, wind vulnerability analyses and data from damage surveys.

Reviewed and discussed commercial residential loss data and its use in vulnerability function development and validation.

Reviewed the peer reviews of Dr. Joseph Minor, Dr. Carol Friedland, Dr. Marc Levitan, David Rosowsky, Jay Crandell, and Tom Smith in Vulnerability Binder #17, Building Code Project – Reviewers Comments – Update to 2010 US Hurricane Vulnerability Model.

Discussed the comprehensive update to the vulnerability model component. Reviewed and discussed vulnerability relationships using loss data and engineering surveys.

Reviewed samples of vulnerability functions for frame, masonry, mobile homes, contents, and ALE. Reviewed comparisons of the new version 12 vulnerability functions to the previous version 11 vulnerability functions.

Discussed the relationship between building and contents damage for wood frame, masonry, and mobile homes. Verified no change in the contents damage functions for single family homes from the previous accepted submission. Reviewed updated contents damage functions for renters and condos. Reviewed contents damage functions for mobile homes.

Reviewed supporting data and published research for content structure damage relation.

Reviewed updated ALE damage function for single family homes. Verified no change in the renters and condo ALE damage functions from the previous accepted submission.

Discussed the changes to both the methodology and data that led to the update of vulnerability functions.

Discussed the use of height and year built information to further characterize the vulnerability of buildings.

Discussed the development of probability distributions around the mean damage ratios at a given windspeed threshold. Reviewed schematic of the probability damage distribution. Reviewed graphs showing the distribution of 0.1%, 5% and 20% mean damage ratio.

Reviewed the standard deviation for the model distribution for the mean damage ratios 0.1%, 5%, and 20%.

Reviewed validations of the probability damage distribution comparing observed versus modeled losses for storms and companies in Vulnerability Binder – Vulnerability Distribution Validation for 2010 US Hurricane Model Version 12.0.

Discussed how the vulnerability functions account for building height. Reviewed residential vulnerability by number of stories. Reviewed data analysis using the 2004 and 2005 Florida storms. Reviewed comparison by county of residential vulnerability by number of stories.

Reviewed the modifications to the vulnerability functions due to building codes and post disaster surveys. Discussed the influence in wind vulnerability of literature reviewed for year built.

Discussed the explicit modeling of the evolution of building codes and their enforcements across all hurricane states.

Reviewed sample wood frame damage functions by year built.

Reviewed claims data graph comparison of structure year built versus mean damage ratio for Florida and Gulf States.

Reviewed flow diagram of the methodology for estimation of spatial and temporal relativity for all US hurricane states.

Reviewed table of the Florida building code periods with typical buildings for residential construction in the current model. Discussed the change in methodology from the previous submission.

Discussed 2001 Florida Building Code typical building assumptions for the 6 regions in Florida.

Reviewed 6 regional vulnerability curves post 2001 Florida Building Code for wood frame.

Reviewed year built modification factors validation using 2004 and 2005 residential data from Florida storms.

Reviewed new personal residential data received for 2004 and 2005 storms.

Reviewed Figures 22 to 27 with *x* and *y* axis scales shown.

Verified Figures 22 to 27 were updated with recent storms.

Discussed Figures 22 to 25 being unique for this particular combination of company and event. Reviewed validation data scatter plots for Coverage A, Coverage C, and Coverage D.

Reviewed validation data plots for commercial residential exposure for reinforced concrete. Discussed data being very limited for commercial residential, e.g., for reinforced concrete only data for 2004 storms is available.

Reviewed tables for the 20 different residential construction types and how they relate to the vulnerability functions.

Reviewed updated plot in Attachment F reflecting the latest storms and data in comparing the current version 12 model to the previous version 11 model.

Reviewed validation for the 40 mph minimum windspeed. Verified no change from the previous accepted submission.

Reviewed flowchart for Form V-1 creation. Discussed AIR did not use the windspeeds provided by the Commission to generate Form V-1. Reviewed table of ZIP Code windspeeds comparing the previous, current, and Commission windspeed data.

Discussed the discrepancies from the upper to lower windspeed bounds. Subsequently Form V-1 was revised in the submission.

Reviewed ALE damage function for apartment/condos.

Reviewed vulnerability functions and assumptions for commercial residential high rise buildings.

Reviewed claims data from Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Katrina (2005), Hurricane Rita (2005), and Hurricane Wilma (2005) for loss validation of commercial residential vulnerability functions.

Interviewed Drs. Carol Friedland and Marc Levitan on the phone regarding their review of the version 12 model and submission. Discussed their expertise with hurricane impacts on buildings. Discussed the extent and scope of their review of material provided to them and their meetings and discussions with AIR personnel.

V-2 Mitigation Measures

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

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

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

Audit

1. Forms V-2 and V-3 (Trade Secret List item) provide the information used in auditing this Standard.

2. Individual mitigation measures as well as their effect on damage due to use of multiple mitigation measures will be reviewed. Any variation in the change over the range of windspeeds for individual and multiple mitigation measures will be reviewed.

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

Pre-Visit Letter

Provide five (5) printed copies of Form V-3 and the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

71. V-2.A, page 110: Explain what is meant by "Algorithms for modifying the vulnerability functions, for both structural and nonstructural damage, are developed based on engineering principles and building performance observations."

72. V-2, Disclosure 2, page 111: Discuss the interaction between Table 7 and Form V-2. (Commission issue)

73. V-2, Disclosure 3, page 112: Provide the basis and how the two types of weights are used in modeling mitigation and the dependency of the weights on windspeed. Describe how the roof system loss contribution is combined with other building systems contributions to develop loss functions for a building. Clarify the example provided in the response. (Commission issue)

75. Form V-2, page 119: Demonstrate how the values given in Form V-2 have been developed and why the values have increased from the previous submission.

76. Form V-2, pages 119-123: Explain the values in Form V-2 and Table 7 that are the same; e.g., engineered shutters, impact glass. (Commission issue)

77. Form V-2, page 121: Explain the values given for roof pitch in Table 8. (Commission issue)

78. Form V-2, page 123: Explain why No Appurtenant Structures modifies the base damage functions in Table 8.

79. Form V-2, page 123: Discuss why Fully Engineered, Partially Engineered, and Minimally Engineered do not impact the base damage functions in Table 8. Compare these zero-impact factors with the statement to the contrary given in response to Standard V-1, Disclosure 3 on page 105.

Trade Secret Information to be presented to the Professional Team (page 8):

- V-2 – Source data and methodology used to reflect impact of mitigation factors; Form V-3

Verified: YES

Professional Team Comments:

Discussed the methodology of the individual risk model. Reviewed the impact of the secondary risk features to the base building damageability. Reviewed examples of modified vulnerability functions.

Reviewed options available for typical individual risk features for window glass type, window protection, roof pitch, roof covering, and roof deck. Discussed assumptions made for unknown mitigation factors.

Reviewed example modification function for plywood storm shutters reflecting the dependency of the secondary risk features impact on windspeed.

Reviewed the impact of mitigation features in combination. Verified the combined impact is not equal to the linear sum of the impact of individual features. Reviewed the corresponding methodology implementation in source code.

Reviewed the updates to the individual risk model based on new engineering reports, damage survey reports, continuing education conferences, and published research. Discussed latest research on wind driven water and soffits.

Discussed the modeling assumptions made for engineered shutters and impact resistant laminated glass.
Reviewed damage survey site inspections for Hurricane Gustav (2008) and Hurricane Ike (2008).

Reviewed validation of the individual risk model using detailed data from the 2004 and 2005 Florida hurricanes. Reviewed comparisons of modeled versus observed for roof covering, window protection, roof geometry, roof attachment, and roof deck attachment.

Reviewed validation results for selected buildings, comparison of modeled versus observed for a bad building with a gable roof, a bad building with a hip roof, a good building with clips, and a good building with ties.

Discussed the interaction between Table 7 of the original submission and Form V-2. The reference to Table 7 in relation to Form V-2 was updated.

Discussed the two primary metric rates and weights used in modeling mitigation. The rates are a weighted value assigned to the various options for building or environmental features. Clarified the example from the submission is windspeed dependence of roof covering and roof deck. Reviewed comparison of asphalt shingles, plywood deck, and asphalt shingles plus plywood deck of the percent of modification to the damage function versus windspeed.

Reviewed and discussed the two types of weights for mitigation features and their dependence on windspeed. The corresponding pages in submission were subsequently revised.

Discussed the changes in values in Form V-2 are related to the enhancements in the individual risk model.

Reviewed flow chart of Form V-2 creation.

Reviewed Form V-3. Confirmed consistency between Form V-3 and the submitted Form V-2.

Discussed the assumption that the mitigation value of engineered shutters and impact resistant glass being the same based on current building codes specifying that windows can be protected with approved impact resistant glass or approved shutters.

Discussed the values in Form V-2 for roof pitch. The model produces credits for high-pitch roofs due to the lower uplift pressure and suction pressures on these roof types.

Discussed the Table 8 of the original submission relationship to referenced frame structure in Form V-2.

Discussed the new seal of approval feature in the individual risk model that accounts for the level of engineering in the design of the structure. Discussed and reviewed the corresponding modification factors in Table 8 of the original submission.

Discussed the rationale for no appurtenant structures modifying the base damage functions due to reduction in wind-borne debris.

Discussed duration assumption in preparing Forms V-2 and V-3. The corresponding references to this assumption were modified in the submission.

ACTUARIAL STANDARDS – Marty Simons, Leader

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

*(*Significant Revision)*

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

Audit

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

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

3. The model will be reviewed to determine whether (if so, how) the model takes into account flood or hurricane storm surge.

Pre-Visit Letter

Provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and 2005 hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Loss data is current up through what year? Does the loss data include Citizens data?

80. A-1, Disclosure 2, page 126: Provide a description of the process described relating to the separation of wind and storm surge losses. Describe the process whereby "surge losses were completely excluded from the reported results."

Verified: YES

Professional Team Comments:

Verified no change in the definition of an event or by-passing storm from the previously accepted submission.

Reviewed AIR interpretation of Standard A-1 as it relates to s. 627.4025(2)(c), Florida Statutes. Discussed the modeler's definition of an event as described in the Report of Activities. Reviewed catalog generation requirements documentation updated to clarify Florida hurricane inclusion and corresponding computer code implementation.

Discussed the process for selecting by-passing storms from the North Atlantic Storm catalog.

Discussed and reviewed the process for inclusion or exclusion of storm surge separate from and run in parallel with the wind model.

Reviewed examples of analysis logs showing storm surge is not included in the output results.

A-2 Underwriting Assumptions*

*(*Significant Revision)*

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

B. For loss cost and probable maximum loss level estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) claim payment practices, (4) coinsurance, (5) contractual provisions, and (6) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be appropriate.

Audit

1. Demonstrate how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify model calculations. For example, the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.

2. Provide the percentage of loss at or above which the model assumes a total loss.

Pre-Visit Letter

81. A-2.A, page 127: Provide specific examples of recent (post 2003) adjustments, edits, inclusions or deletions made to client company input data, and describe how they are based upon accepted actuarial, underwriting and statistical procedures.

82. A-2, Disclosure 2, page 128: Provide additional details relating to the statement, "The methodology described above in the response to Disclosure 1 is also used for commercial residential construction types. For a given occupancy-construction-height combination, separate vulnerability relationships are used to estimate losses. If any of these fields are unknown the industry exposure is used to develop a weighted average vulnerability relationship for the unknown field."

83. A-2, Disclosure 3, page 128: Provide additional details relating to the statement, "The model captures the effects of coinsurance through the use of the location level

participation field. This field reflects the percentage of the risk covered by the insurer. Insurers may make specific assumptions to allow for any coinsurance adjustments. If AIR makes assumptions at the client's request regarding coinsurance, such assumptions are included in the PIAF."

Verified: YES

Professional Team Comments:

Discussed the methodology for reviewing claims payment practices of insurance companies and documentation of excluded or adjusted data in the Project Information Assumption Form (PIAF).

Reviewed sample company correspondence and supplemental claims practice questions sent to clients.

Reviewed sample company commercial residential loss PIAF.

Discussed the methodology used for commercial residential construction characteristics including height, if unknown.

Reviewed illustration of how coinsurance adjustments are incorporated at a client's request. Verified all coinsurance assumptions are disclosed in the PIAF.

Reviewed coinsurance formulae used in calculations.

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

*(*Significant Revision)*

A. Loss cost projections and probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

B. Loss cost projections and probable maximum loss levels shall not make a prospective provision for economic inflation.

C. Loss cost projections and probable maximum loss levels shall not include any provision for direct hurricane storm surge losses.

D. Loss cost projections and probable maximum loss levels shall be capable of being calculated at a geocode (latitude-longitude) level of resolution.

Audit

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

Pre-Visit Letter

84. A-3, Disclosure 1, page 131: Provide justification for if and how the model computes average annual losses (AAL) and exceedance probability (EP) curves. Provide justification for if and how the model incorporates uncertainty around the mean loss (as mentioned in the response to Standard V-1.B on page 98) for a given scenario event, in computing AAL and EP curves.

Verified: YES

Professional Team Comments:

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

Reviewed methodology for computing average annual losses and exceedance probability curves.

Reviewed model variability distributions around the mean damage ratio for a mean damage ratio of 0.1%, 5%, and 20% and for several companies data.

A-4 Demand Surge*

*(*Significant Revision)*

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

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

Audit

1. Provide the data and methods used to incorporate individual aspects of demand surge on personal and commercial residential coverages, inclusive of the effects from building material costs, labor costs, contents costs, repair time, etc.

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

Trade Secret Information to be presented to the Professional Team (page 8):

- A-4 – Demand Surge Analysis

Verified: YES

Professional Team Comments:

Verified no change in the accepted methodology for demand surge calculations from the previous submission.

A-5 User Inputs

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

Audit

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

2. All model inputs and assumptions will be reviewed to determine that the model output report appropriately discloses all modifications, adjustments, assumptions, and defaults used to produce the loss costs.

Trade Secret Information to be presented to the Professional Team (page 8):

- A-5 – User Inputs

Information to be presented to the Professional Team:

- A-5.2, pages 136-137 – 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

Professional Team Comments:

Reviewed example of Data Processing Checklist.

Reviewed the Unicede®/px Data Exchange Format Preparer's Guide, Product Version 12.0, Release Date June 2010 documenting the process used to transfer client exposure and claims data into the model.

Reviewed the CLASIC/2™ User's Guide, Product Version 12.0, Release Date June 2010 manual documenting the analysis options available for generating modeled losses.

Discussed analysis log generated with model runs that disclose all selections included by the user of the model. Attachment A of the submission contains a sample analysis log.

A-6 Logical Relationship to Risk*

*(*Significant Revision)*

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

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

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

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

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

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

G. The relationship of loss costs for individual coverages, (e.g., structures and appurtenant structures, contents, and time element) 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. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, and A-5 will be used to assess coverage relationships.

Pre-Visit Letter

85. A-6, Disclosure 2, page 145: Explain the modeled values at the upper and lower extremes that fall outside of the historical values in Figure 34.

86. Form A-1, pages 163-165: For ZIP Code 33001, construction type 1 (wood frame), structure, content, and additional living expense loss costs are 0.019306, 0.010409, and 0.0138889, respectively. For construction type 3 (mobile home), the corresponding values are 0.030647, 0.017341, and 0.011308, respectively. Explain

why the additional living expense loss costs are higher for wood frame than mobile home.

87. Form A-2, pages 166-168: Explain the apparent anomalies in Figures 42, 43, and 44 for ZIP Code loss costs <1 surrounded by loss costs >3. (Commission issue)

88. Form A-3, page 172: Describe method for identifying "Other Hurricanes."

89. Form A-4, pages 174-182: Provide a map showing the hurricane track and:
    a. The ZIP Codes included in the current submission that were not included in the previous submission. Explain why ZIP Code 33971 not included in the previous submission has ~ $2.6 million loss in the current submission.
    b. ZIP Code 33133. Explain why the losses decreased by more than $810 million from the previous submission.
    c. ZIP Code 33189. Explain why the losses increased by more than $430 million from the previous submission.
    d. ZIP Code 33921. Explain why the losses increased by more than $3.4 million from the previous submission.
    e. ZIP Code 33147. Explain why the losses decreased by more than $120 million from the previous submission.
    f. ZIP Code 33156. Explain why the losses increased by more than $260 million from the previous submission.
    g. ZIP Code 33157. Explain why the losses decreased by more than $630 million from the previous submission.

Verified: YES

Professional Team Comments:

Reviewed maps of the average friction factor with easterly wind, with no wind and for Hurricane Andrew (1992).

Reviewed scatter plot of actual versus simulated losses at various windspeeds. Verified observed loss data is at the location level, while validation data is at a ZIP Code level.

Discussed ALE damage function for wood frame being higher than for mobile home dependant upon the windspeed. Reviewed ALE damage functions for wood frame and mobile home. Discussed impact of new coastal segment in the Florida Keys.

Discussed how the maps for Form A2 were generated and the reasonableness of the apparent anomalies due to missing inland ZIP Codes.

Reviewed map of windspeed changes and corresponding loss costs changes for Hurricane Andrew (1992).

Reviewed revised Forms A-4 and A-5 to correct the percentage of loss to each ZIP Code for personal residential.

A-7 Deductibles, Policy Limits, and Coinsurance*

*(*Significant Revision)*

A. The methods used in the development of mathematical distributions to reflect the effects of deductibles, policy limits, and coinsurance 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.

D. The effects of coinsurance on commercial residential loss costs produced by the model shall be actuarially sound.

Audit

1. Describe the process used to determine the accuracy of the insurance-to-value criteria in data used to develop or validate the model results.

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

3. Justify changes from the previously accepted submission in the relativities among corresponding deductible amounts for the same coverage.

Verified: YES

Professional Team Comments:

Discussed the process for documenting assumptions made by the client for both replacement cost and insurance-to-value criteria in the Project Information Assumption Form.

Verified no change in the process for calculating and applying deductibles and policy limits from previously acceptable formulae and methodologies.

A-8 Contents*

*(*Significant Revision)*

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

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

Audit

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

2. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Verified: YES

Professional Team Comments:

Reviewed statistical analyses by company for difference of simulated and actual losses for contents coverage.

Verified relativities between loss costs for structures and corresponding loss costs for contents have not changed for homeowner's and mobile home from previously accepted submission. Reviewed the changes in relativities for renter's and condo owners.

Reviewed distribution of contents versus building damage.

Documentation reviewed:

- Florida Public Hurricane Loss Projection Vulnerability Model: Implementation and Validation, Pinelli et al. (2005)

A-9 Time Element Coverage*

*(*Significant Revision)*

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

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

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

D. Time element loss costs produced by the model shall appropriately consider time element claims arising from indirect loss.

Audit

1. Documentation and justification of the following will be reviewed:
   a. The method of derivation and data on which the time element vulnerability functions are based;
   b. Validation data specifically applicable to time element coverages;
   c. Assumptions regarding the coding of time element losses by insurers;
   d. The effects of demand surge on time element for Hurricane Andrew (1992) and the 2004 and 2005 hurricane seasons;
   e. Assumptions regarding the variability of time element losses by size of property;
   f. Statewide application of time element coverage assumptions;
   g. Assumptions regarding time element coverage for mobile homes, tenants, and condo unit owners exposure;
   h. The methods used to incorporate the estimated time required to repair or replace the property;
   i. The methodology and available validation for determining the extent of infrastructure damage and its effect on time element costs.

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

Verified: YES

Professional Team Comments:

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

Discussed the methodology and data used for development of the time element vulnerability functions. Discussed assumptions regarding time element coverage, e.g., size of property, type of exposure.

Discussed the outside source used to incorporate the estimated time required to repair or replace damaged property.

Reviewed statistical analysis by company for difference between simulated and actual losses for time element coverage.

A-10 Output Ranges*

*(*Significant Revision)*

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

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

1. masonry construction versus frame construction,

2. personal residential risk exposure versus mobile home risk exposure,

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

4. in general, northern counties versus southern counties.

Audit

1. Forms A-6, A-7, and A-8 will be reviewed. The sample output range report produced by the model for commercial residential loss costs will be reviewed.

2. Justify all changes from the previously accepted submission using the 2007 Florida Hurricane Catastrophe Fund aggregate personal residential exposure data.

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

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

Pre-Visit Letter

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

86. A-10, Disclosure 6, pages 159-160: Discuss the output range form for commercial residential loss costs. (Commission issue)

90. Form A-6, page 237: Describe in detail what is driving the changes to counties such as Franklin, Holmes, Jefferson, Madison, Suwannee, and Washington for frame. Also, frame is up over 100% for Escambia from the previous submission while Santa Rosa and Lake are up around 80%. Mobile home in Sumter is 4 times its frame value which appears unusual compared to other counties' ratios.

91. Form A-7, page 298: Describe in detail the causes of each of the changes presented on Form A-7 from the loss costs presented in the previous submission.

92. Form A-8, page 299: Explain the results shown in Figure 63 for Frame for the following counties:
    a. Franklin and Gulf
    b. Flagler and Volusia
    c. Charlotte
    d. Monroe

93. Form A-8, page 300: Explain the results shown in Figure 64 for Masonry for the following counties:
    a. Franklin and Gulf
    b. Flagler
    c. Volusia
    d. Charlotte
    e. Miami-Dade

94. Form A-8, page 301: Explain the results shown in Figure 65 for Mobile Homes.

95. From A-8, page 302: Explain the results shown in Figure 66 for Frame Renters for the following counties:
    a. Flagler
    b. Franklin

96. Form A-8, page 303: Explain the consistent geographical effects in Figure 67 for Masonry Renters in light of all the model changes.

97. Form A-8, page 304: Explain the results shown in Figure 68 for Frame Condos for the following counties:
    a. Gulf
    b. Dixie
    c. Union
    d. Flagler
    e. Miami-Dade

98. Form A-8, page 305: Explain the results shown in Figure 69 for Masonry Condos for the following counties:
    a. Gulf and Franklin
    b. Dixie

Verified: YES

Professional Team Comments:

Reviewed the results provided in the output ranges.

Discussed and reviewed the changes in Forms A-6, A-7, and A-8 from the previous submission due to (1) the change in handling the FHCF exposure data, (2) the discontinuation of the weights file, and (3) the model changes from version 11 to version 12.

Reviewed revised version of Forms A-6, A-7, and A-8 generated to reflect only the model changes from version 11 to version 12.

Discussed the reasonableness of the anomalies highlighted in the submission relative to the changes in the model from version 11 to version 12.

Discussed ratio of mobile home to home owner frame loss costs for Sumter, Lake, Marion, and Polk counties.

Reviewed summary of directional change in losses at the component level.

Discussed in detail the explanations for the changes in losses due to the hazard and vulnerability model updates for Charlotte, Monroe, Flagler, Franklin, Gulf and Miami-Dade counties.

Reviewed map of percentage change in weighted average 2% deductible loss costs by county for frame owners.

A-11 Probable Maximum Loss*

*(*Significant Revision)*

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

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-9. (Trade Secret List item)

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

Verified: YES

Professional Team Comments:

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

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

1. Forms S-1, S-2, and S-3 will be reviewed. Provide justification for the distributions selected including, for example, citations to published literature or analyses of specific historical data.

2. The modeling organization characterization of uncertainty for windspeed, damage estimates, annual loss, and loss costs will be reviewed.

Pre-Visit Letter

99. S-1, Disclosure 1, page 313: Describe the "meteorological adjustments" (in addition to smoothing) made when deriving landfall location distributions.

100. S-1, Disclosure 1, page 314: Review the GWRF and PWF fits, with data to be provided while the Professional Team is on-site, for evaluation. Be prepared to review all distribution fit updates.

101. S-1, Disclosure 2, page 315: Describe the process used to resolve inconsistencies between the DeMaria extended best track and the H*Wind analyses.

Verified: YES

Professional Team Comments:

Reviewed graphical comparisons of the meteorological adjustments made when deriving landfall location distributions: Historical versus Smoothed Frequencies and Historical versus Modeled Frequencies by 50-mile coastal segments.

Reviewed fits for GWRF and PWF. Updated fits were also reviewed. Binder documenting the fits and Forms S-1, S-2, and S-3 were reviewed.

Reviewed the model for Rmax post-landfall based on radar analyses.

Discussed the independent use of the DeMaria extended best track and H*Wind datasets for validation.

Reviewed following assessments of uncertainty in loss costs:

- the impact of removing stochastic GWRF on the distribution of modeled losses
- the impact of removing stochastic PWF on the distribution of modeled losses
- the impact of removing stochastic GWRF on the average annual losses
- the impact of removing stochastic PWF on the average annual losses.

Reviewed results provided in Forms S-1, S-2, and S-3. Reviewed a corrected Form S-2.

S-2 Sensitivity Analysis for Model Output*

*(*Significant Revision due to requirement of Form S-6)*

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

Audit

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

2. Form S-6 will be reviewed.

Trade Secret Information to be presented to the Professional Team (page 8):

- S-2 – Results of sensitivity studies for hurricane model losses and input variables

Pre-Visit Letter

102. S-2, S-3, and Form S-6: AIR's completion of Form S-6 identified GWRF as the dominant input parameter.
    a. Comment on the strength of the GWRF parameter.
    b. If not covered in the earlier discussion of GWRF, how is it implemented in the model? Does implementation include the uncertainty as posited in Form S-6? What is AIR's recommendation for handling the stochastic nature of GWRF?
    c. In view of GWRF dominance, does the ordering of the remaining input parameters CP, Rmax, VT, FFP, and PWF agree with your expert knowledge?
    d. Comment on PWF as to its relative importance and its inclusion in the revised model.
    e. Comment on the relative importance of the far field pressure in the current windfield model compared to the previous windfield model. Discuss the treatment of far field pressure as a fixed or stochastic variable in the model.

Verified: YES

Professional Team Comments:

Reviewed the results from Form S-6. Loss cost summary results were reproduced by the Professional Team. Windspeed results were reasonable from both a statistiscal and meteorological perspective.

Reviewed contour plots with temporal animation for several storms including category 1 and category 5.

S-3 Uncertainty Analysis for Model Output*

*(*Significant Revision due to requirement of Form S-6)*

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

Audit

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

2. Form S-6 will be reviewed.

Trade Secret Information to be presented to the Professional Team (page 8):

- S-3 – Results of uncertainty studies for hurricane model losses and input variables

Verified: YES

Professional Team Comments:

Reviewed the results from Form S-6. Windspeed results were reasonable from both a statistical and meteorological perspective.

Discussed analyses of hurricane parameter sensitivities.

S-4 County Level Aggregation

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

Audit

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

Trade Secret Information to be presented to the Professional Team (page 8):

- S-4 – Graphs assessing the contribution to error in loss costs by county

Verified: YES

Professional Team Comments:

Reviewed several graphs illustrating the convergence at 50K years of simulation.

Reviewed comparison of 50K to 100K results for several counties.

S-5 Replication of Known Hurricane Losses*

*(*Significant Revision)*

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

Audit

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

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

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

4. Form S-4 will be reviewed.

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

Verified: YES

Professional Team Comments:

Reviewed validation comparisons provided in Form S-4.

Discussed the exposure and claims data provided by companies for the validation comparisons and the changes in storm windfield footprints.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-5 will be reviewed for consistency with Standard G-1, Disclosure 5.

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

Verified: YES

Professional Team Comments:

Reviewed map of the average annual loss by county due to by-passing hurricanes.

Reviewed map of the average annual loss by county for hurricanes with two landfalls impacting Florida.

Verified no departures from the windfield, vulnerability functions or insurance functions applied to the actual hurricanes for validation.

Reviewed Form S-5.

COMPUTER STANDARDS – Paul Fishwick, Leader

Trade Secret Information to be presented to the Professional Team (page 8):

- Computer Standards – All software, documentation, specifications, and procedures as specified in the audit section of each standard

C-1 Documentation

A. The modeling organization 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 submission shall be consistently documented and dated.

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

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

Audit

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

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

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

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

5. Provide verification that documentation is created separately from and is maintained consistently with the source code.

6. The tables specified in C-1.C that contain the items listed in Standard G-1, Disclosure 5 will be reviewed. The tables shall contain the item number in the first column. The remaining five columns shall contain specific document or file references for affected components or data relating to the following Computer Standards: C-2, C-3, C-4, C-5, and C-6.

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

Information to be presented to the Professional Team:

- C-1.A, page 352 – The primary document binder set (10 binders total), which contains fully documented sections for each computer standard, shall be available for inspection by the Professional Team.
- C-1.B, page 352 – All components as defined by the Requirements are fully documented and such documentation shall be available for review by the Professional Team.
- C-1.D, page 352 – Documentation is provided via in-line detailed comments and external, higher-level documentation that shall be able to be available for review by the Professional Team.

Pre-Visit Letter

103. C-1.C, page 352: Relate the table of contents with the response to Standard G-1, Disclosure 5 on page 29 by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Reviewed changes/documentation mapping for each of the model changes identified in Standard G-1, Disclosure 5.

Reviewed the primary document binder containing:

CLASIC/2 Model 21 Version Change History
CLASIC/2 Release Notes, version 11.0
CLASIC/2 Release Notes, version 11.5
CLASIC/2 Installation and System Configuration
CLASIC/2 System Requirements
CLASIC/2 Update Instructions
Getting Started with CLASIC/2
CLASIC/2 Reference Guide
CLASIC/2 User's Guide
Glossary
AIR ImportExpress for CLASIC/2 User's Guide
CLASIC/2 Database Reference Manual
Managing CLASIC/2 Databases with AIRDBAdmin
UNICEDE/px Data Exchange Format Preparer's Guide
UNICEDE/fx Data Exchange Format Preparer's Guide
Using the Storm Surge Model for the AIR US Hurricane Model

Reviewed the CLASIC/2 documents to be released in June 2010 for the most recent modifications reviewed in the version 12.0 model.

Reviewed the table required in Standard C-1.C

Verified the traceability for model changes specified in Standard G-1, Disclosure 5 through all Computer Standards

Reviewed accessibility of all documentation electronically in AIRPort and in print.

Discussed the process for updating and reviewing model documentation.

Discussed the process for creating model documentation. Verified model documentation is created separately from, and is maintained consistently with, the source code.

Discussed the independent code review by Narges Pourghasemi.

C-2 Requirements*

*(*Significant Revision)*

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

Audit

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

Information to be presented to the Professional Team:

- C-2, page 353 – CLASIC/2 documentation specifying model requirements and computer implementation for each software component shall be available for verification by the Professional Team. The version-specific software and model requirements are defined and shall be available for verification by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed requirements documentation for all changes implemented in version 12.0 as identified in Standard G-1, Disclosure 5.

Reviewed the assumptions associated with the stochastic hurricane parameters in Form S-3.

Reviewed specific requirements related to modified and new windfield and damage functions.

Reviewed the requirements binder containing:

CLASIC/2 Release-Based Enhancements
Model 21 and CLASIC/2 Enhancements and Florida Commission Documentation Mapping
Model 21 Requirements
Catalog Generation Requirements
Physical Properties Requirements
ZIPAll Requirements
HURSIM Requirements
Individual Risk Requirements
Loss Data Requirements
Demand Surge Requirements
CLASIC/2 Requirements Summary
Data Sources and Third Party Applications

C-3 Model Architecture and Component Design

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

Audit

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

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

Information to be presented to the Professional Team:

- C-3, page 354 – The component design documents include detailed control and data flow diagrams, and class diagrams for all other portions of the U.S. hurricane model and CLASIC/2 system. These documents shall be available to the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the data flowchart defining steps in location-specific windspeed calculation, including its functional components.

Reviewed the process for detailed control and data flow diagrams, completely and sufficiently labeled for each model component.

Reviewed Model 21 (US Hurricane Model) flowchart documentation.

Reviewed the flowchart for implementation of the updated GWRF factor.

Reviewed flowchart illustrating how changes in HURDAT database are used in the calculation of landfall distribution.

Reviewed the flowchart for calculating damage for different coverages.

Discussed the interface specifications for all components in the model.
Discussed the changes in schemas for the updated databases.

Reviewed the location of the network diagrams for the model components.

Reviewed flow diagram of the individual risk model.

Reviewed the model architecture and component design binders containing:

Event Generation Flowcharts
CLASIC/2 Overview
CLASIC/2 Presentation Layer
CLASIC/2 Business Layer
CLASIC/2 Common Services Layer
CLASIC/2 Loss Analysis Process – Loss Analysis Engine
CLASIC/2 Hazard Model Framework
CLASIC/2 Data Access Layer
CLASIC/2 AirAreaCode Database Reference Manual
CLASIC/2 AirCL2Exp Database Reference Manual
CLASIC/2 AirCL2Loss Database Reference Manual
CLASIC/2 AirCommon Database Reference Manual
CLASIC/2 AirExpWork Database Reference Manual

C-4 Implementation

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

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

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

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

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

F. The modeling organization shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosure 5:

1. A list of all equations and formulas used in documentation of the model with definitions of all terms and variables.

2. A cross-referenced list of implementation source code terms and variable names corresponding to items within F.1.

Audit

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

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

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

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

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

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

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

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

Information to be presented to the Professional Team:

- C-4.1, page 356 – The document, Model 21 Equations/Formulas and Variable Mapping, shall be available to the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed documentation demonstrating the code and data interface coupling assumptions.

Discussed the process for verifying that the documented coding guidelines are consistently implemented.

Reviewed table of all software components with the file name, number of comment lines, number of code lines, and total lines.

Discussed the traceability among components.

Reviewed documentation providing the component name, date created, dates modified and by whom, function of the component, and the input and output parameter definitions.

Reviewed the method for mapping equation-based model components to computer code elements.

Reviewed updated Model 21 Equations/Formulas and Variable Mapping containing the mappings related to the Physical Properties.

Reviewed computer code for the Willoughby radial decay function.

Reviewed computer code for the GWRF adjustment.

Reviewed computer code for friction and gust factors.

Reviewed computer code for random number generation for uniform and normal distributions.

Reviewed computer code for transitioning from the base vulnerability function to the Form V-2/V-3 reference structure vulnerability function.

Reviewed computer code for determining damage functions for geographic regions.

Reviewed computer code for modification of vulnerability functions for shutters.

Reviewed computer code for application of mitigation factors individually and in combination.

Reviewed the implementation binders containing:

Development, Implementation, and Validation Processes

Research

AIR Tropical Cyclone Model for the U.S. Gulf and East Coasts

Catalog Generation
- *Catalog Generation Code*
- *Data Files for Catalog Generation*

U.S. Physical Properties
- *Physical Properties Generation Code*
- *Data Files for Generating U.S. Physical Properties*

ZIPAll
- *ZIP Centroid and ZIPAll Creation Summary and Verification*

HURSIM
- *HURSIM-Technical Overview*
- *HURSIM - Data Files*

Individual Risk
- *Individual Risk Technical Overview*
- *Data Files for Individual Risk*

Loss Data
- *Loss Data Technical Overview*
- *Data Files for Loss Data*

Demand Surge
- *Demand Surge Validation and Implementation*
- *Data Files for Validation and Calculation of Demand Surge*

Model 21

Model 21 Technical Overview
Model 21 Data Files
Model 21 2010 Data Files
Model 21 Flowcharts

Datafile Converter
Using Data File Converter

CLASIC/2
Setting up a CLASIC/2 Developer's Environment
CLASIC/2 Feature Design and Implementation Process
Implementing New Perils and Models in CLASIC/2
Creating Maps in CLASIC/2
Updating the AirCL2Ind Database
Updating the ZIP Code Information in the AirAreaCode Database ZIPAll 2009
Building CLASIC/2
CLASIC/2 Registry Settings
Output Range Reports – Guidelines for Preparation
Probable Maximum Loss – Guidelines for Preparation

Formulas/Equations/Variable Mapping
Model 21 Equations/Formulas and Variable Mapping

Error Code Documentation
FORTRAN – Catalog Generation Error Codes
FORTRAN – Physical Properties Error Codes
Model 21 - Error Codes
Datafile Converter Error Codes
CLASIC/2 Engine Errors and Descriptions

Line Counts
FORTRAN Catalog Generation Line Count
FORTRAN - Physical Properties Line Count
ZIP SQL Script Line Count
Datafile Converter - Line Count
CLASIC/2 Engine and Model 21 Line Counts

Coding Guidelines
FORTRAN Coding Guidelines
C++/COM Coding Guidelines
C#/.Net Coding Guidelines
Java Coding Guidelines
Technical Documentation Guidelines

C-5 Verification

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

2. The testing software used by the modeling organization will be reviewed.

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

4. Flowcharts defining the processes used for manual and automatic verification will be reviewed.

5. The response to Disclosure 1 will be reviewed.

Information to be presented to the Professional Team:

- C-5.A, page 361 – Examples of these verification procedures, including code inspections, reviews, calculation crosschecks, walk-through, and the use of logical assertions and exception-handling mechanisms in the code, are described within the documentation and shall be available to the Professional Team. The verification process for all model and software components is discussed in the Model 21 and CLASIC/2 Development, Implementation, and Validation Process document in Binder C-4 and shall be available to the Professional Team.
- C-5.B, page 362 – A complete set of CLASIC/2 test plans used by the Software Quality Assurance group and Model tests used by Core QA are available and shall be available to the Professional Team.
- C-5.C, page 362 – Examples of the verification, including counts on the ZIP changed records, county change records, and ZIP centroid updates, are described with the documentation and shall be available to the Professional Team.
- C-5.2, page 363 – The verification process for all model and software components is discussed in the Model 21 and CLASIC/2 Development, Implementation, and Validation Process document in Binder C-4 and shall be available to the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the data processing checklist defining the procedures used upon receipt of new client data.

Discussed implementation of flag-triggered output statements and statements for error and exception handling.

Reviewed the computer code used to verify the equivalence between the previous FORTRAN-based and current SQL-based approaches in the ZIP Code data processing.

Discussed the testing software and verification procedures.

Reviewed documentation of data test procedures for damage functions.

Discussed the process for model and software testing by the modeler quality assurance groups.

Reviewed the model development and validation process flow chart.

Reviewed the verification binder containing:

Research
Catalog Generation Code Testing

Physical Properties Generation Code Testing
Individual Risk Testing
Loss Data Testing

Model 21
Model 21 – Testing for CLASIC/2
Unit Testing of Model 21 in CLASIC/2
Model 21 Basic QA Test Cases
Model 21 Final QA Test Cases

Datafile Converter
Datafile Converter - Testing

CLASIC/2
CLASIC/2 QA Test Tools
CLASIC/2 Code Verification
CLASIC/2 Functional Test Plan

C-6 Model Maintenance and Revision

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

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

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

D. The modeling organization shall maintain a list of all model versions since the initial submission for this year. Each model description shall have a unique version identification, and a list of additions, deletions, and changes that define that version.

Audit

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

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

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

Information to be presented to the Professional Team:

- C-6.D, page 364 – The Model 21 and CLASIC/2 Version Change History document identifies all component changes for the U.S. hurricane model and CLASIC/2 application, including the additions, deletions, and updates for all version starting with Version 10.0. This document shall be available to the Professional Team.
- C-6.1, page 365 – We are prepared to demonstrate these systems and methodologies during the Professional Team's site visit.

Pre-Visit Letter

104. C-6.D, page 364: Provide the model version history leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed Model 21 and CLASIC/2 version change history documentation.

Reviewed documentation used to maintain code, data, and documentation.

Verified no changes to the model revision policy from previously accepted policy.

Discussed the tracking software and verified no change in methodology from the previously accepted model.

Reviewed the model maintenance and revision binder containing:

AIR Documentation Control Process
Model and Software Change Control Process
Model and Software Revisions and Versioning
Model 21 and CLASIC/2 Version Change History
AIR Data Control Workbook

C-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed the security policy and updated documentation for disaster recovery processes.

Reviewed multiple levels of security involved in code inspections in the course of the audit.

Reviewed the security binder containing:
AIR Code, Data and Documentation Security Policy