Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2007 Standards

AIR Worldwide Corporation

On-Site Review
March 25-27, 2008

On March 25-27, 2008, the Professional Team visited on-site at AIR Worldwide Corporation (AIR) in Boston, Massachusetts. The following individuals participated in the review.

AIR

Tanya Bedore, Technical Writer
Jason Butke, Research Scientist, Meteorology Division
Joe Cleveland, Risk Analyst
Justin Cox, Ph.D., Research Scientist/Meteorologist
Peter Dailey, Ph.D., Director, Atmospheric Science
Ioana Dima, Ph.D., Research Scientist/Meteorologist
Stephen Dobro, Quality Assurance Manager
Tim Doggett, Ph.D., Senior Research Scientist
Jeff Evangelista, Computer Science
Jayanta Guin, Ph.D., Senior Vice President
Cheryl Hayes, Manager, Exposure Group
Hua He, Ph.D., Research Engineer
Mary Healy, Ph.D., Research Statistician
Vineet Jain, Ph.D., Project Manager
Bethany Kocher (via phone)
David Lalonde, FCAS, FCIA, MAAA, Senior Vice President, Consulting Services
Nick Lamparelli, Consulting Group
S. Ming Lee, President
Greta Ljung, Ph.D., Senior Research Statistician
Stuart Miller, Ph.D., Risk Consultant
Joseph Minor, Ph.D., P.E., Consulting Engineer (via phone)
Robert Newbold, Assistant Vice President, Consulting Services Group
Sudhir Kumar Potharaju, Senior Software Engineer
Narges Pourghasemi, Independent Auditor (via phone)
John Rollins, Vice President, Actuarial Consulting (via phone)
John Rowe, Manager, Exposure Group

Professional Team

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

The review began with introductions and an overview of the audit process. The Professional Team reviewed AIR's responses to the deficiencies noted at the March 12, 2008 Commission meeting. AIR provided updated Expert Certification Forms G-1, G-2, G-4, and G-7 in response to the deficiencies.

AIR provided an overview of the refinements made to the 2008 model, Atlantic Tropical Cyclone V10.0:

- Updated the historical storm set to incorporate track information from the June 2007 version of HURDAT.
- Updated probability distributions used for annual landfall frequency, landfall location, and storm intensity in the stochastic catalog.
- Updated the ZIP Code database.

The updates to the ZIP Code database resulted in a 0.13% increase in loss costs, and the updates to the event generation module resulted in a 1.09% decrease in loss costs.

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

1. Page 16, G-1.2, clarification on historical datasets used.
2. Page 18, G-1.2, discussion of fetch in the windfield generation description removed.
3. Pages 20-24, additional corrections to references.
4. Page 21, G-1.5, clarification on update to central pressure in the stochastic storm catalog.
5. Page 25, G-1.6, updated response for substantive changes in the submission.
6. Pages 30-36, G-2.2.A and B, updated to include new personnel involved in development and revisions to the model and the submission process.
7. Page 38, G-2.3.A, reference to Dr. John Freeman's review in 1994 removed.
8. Pages 44-50, Forms G-1, G-2, G-4, G-5, G-6, G-7, updated Expert Certification Forms.
9. Page 53, M-2.1, clarification on what correlates to historical and what to stochastic and correction of TPC notation.
10. Page 62, M-3.2, removal of Monthly Weather Review articles and correction of TPC notation.
11. Page 64, M-4.6, correct references.
12. Page 65, M-4.7, roughness clarification.
13. Page 67, M-5, revised to remove reference to fetch.
14. Page 71, M-5.3, revised to include adjustment for distances to coast.
15. Page 71, M-5.4, differences in treatment of decay rates in the model for stochastic versus historical storms.
16. Page 89, V-1.3, clarification on Hurricane Georges and Tropical Storm Frances year.
17. Page 97, Form V-1, second footnote not necessary and will be removed.
18. Page 155, Form A-5, Part B, revised to include correct values.
19. Page 296, S-1.2, clarification that Table 18 relates to stochastic parameters, removal of Monthly Weather Review articles, and correction of TPC notation.
20. Page 323, Form S-4, Part A, revised to include correct values and an explanation for difference in values with Form A-3.

Report on Deficiencies

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

1. Standard G-1, Disclosure 2 (page 18)
   Windfield generation description omits discussion of internal boundary layers and fetch as described under Meteorological Standards.

2. Standard G-1, Disclosure 4 (pages 20-24)
   A comprehensive, rather than representative, list of references is required.

3. Standard G-5 (page 43)
   No response to Standard.

4. Standard M-5, Disclosure 4 (page 71)
   Differences between the treatment of decay rates for historical and stochastic storms are not addressed.

5. Standard A-10, Disclosures 3 & 4 (pages 136-137)
   Provide further justification for changes.

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

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

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

When the Professional Team arrives on-site, a copy of Form V-3 must be available. Also provide the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since 2005 (three years prior). Be prepared to describe any processes used to amend or validate the model that incorporates this data.

NOTE: With respect to the use of the NWS-23 windfield, in its deliberations on May 5, 2007, the Commission expressed the following relevant to Standard M-4:

> "I would expect that a modeling organization would keep track of the literature and be sure to read the relevant papers and certainly not something that appeared in the AMS conference last year and hasn't been peer reviewed, that we wouldn't hold them to that standard. But this is based on stuff that I studied as a graduate student a generation ago."

Provide to the Professional Team all materials AIR intends to present to the Commission in response to this concern.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

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

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

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

Pre-Visit Letter

1. G-1, Disclosure 5, page 24 – Provide details of the revisions to the Event Generation Module and the ZIP Code Database Update.

Trade Secret Information to be presented to the Professional Team (page 8):
- G-1 – Computer model code, databases and files relevant to the submission.

Verified: YES

Professional Team Comments:

Reviewed the updates to the event generation module and the ZIP Code database in detail.

Verified that the June 2007 version of HURDAT has been incorporated in the model for Florida and adjacent states.

Reviewed updated probability distributions for annual frequency, landfall location, and central pressure.

Reviewed the process that AIR used in response to the new Standard G-5.

G-2 Qualifications of Modeler Personnel and Consultants

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

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

Audit

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

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

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

Pre-Visit Letter

2. G-2, Disclosure 2.B, page 36 – Provide a curriculum vita or resume for each of the employees listed.
   - Stephen Dobro, Computer Science
   - Jeffrey Evangelista, Computer Science
   - Robert Newbold, Computer Science
   - John Rollins, Actuarial Science
   - Enis Simsek, Computer Science

3. G-2, Disclosure 3.A, page 38 – The disclosure only pertains to *"components as currently functioning in the model."* Hence, inclusion of Dr. Freeman's review in the submission implies that this model component is essentially unchanged in over a decade. This should be considered in light of the Commission's statements quoted above.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Stephen M. Dobro, M.B.A. Bryant College; B.S.E.E. Rensselaer Polytechnic Institute
- Arthur L. Doggett IV (Tim), Ph.D. Geosciences/Atmospheric Science, Texas Tech University; M.S. Geosciences/Atmospheric Science, Texas Tech University; B.S. Meteorology, Lyndon State College
- Kristin K. Estabrook, B.A. English, The University of New Hampshire
- Jeffrey E. Evangelista, M.A. English, Boston College; B.S. English, minor Technical Communications, Northeastern University
- Cheryl A. Hayes, M.A. Energy and Environmental Analysis, Boston University; B.A. Political Science, minor French, Mount Holyoke College
- Stuart B. Miller, Ph.D. Development Studies, London School of Economics; M.A. Latin American Studies (Political Economy), Stanford University; B.A. Economics, Rice University; B.A. Spanish, Universidad de Chile
- Robert Newbold, M.B.A. and M.S. Information Systems, Boston University Graduate School of Management; B.S. Systems Engineering, University of Virginia
- John W. Rollins, M.A. Economics, University of Florida; B.A. Mathematics, Duke University
- Enis H. Simsek, B.S. Physics, Middle East Technical University, Ankara, Turkey

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

Verified that the meteorology component of the model has not been reviewed by independent experts since it was reviewed by Dr. John Freeman in 1994. AIR stated that Dr. Freeman's review was still relevant as they continue to use NWS-23. Discussed removal of the reference to Dr. Freeman's review under Disclosure 3.A.

G-3 Risk Location

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

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

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

Audit

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

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

Pre-Visit Letter

4. G-3.A, page 40 – In light of annual updates, explain the use of the November 2006 USPS ZIP Code database.

5. G-3, Disclosure 2, page 41 – Provide detailed description with examples of process described to validate ZIP Codes used in the development or validation of the model.

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 details of the ZIP Code database update. Clarified that the ZIP Code data source is dated January 2007, while originating from the United States Postal Service issue date of November 2006.

Reviewed in detail the process for validating ZIP Codes on data provided by vendor. Discussed how unmodelable ZIP Codes are handled.

Reviewed changes in the current ZIP Code database release. Reviewed ZIP Code centroid comparison summary by state showing ZIP Codes that moved more than one

mile, less than 1 mile, the average movement, and the relative stability of ZIP Code centroids. Exhaustively reviewed examples of ZIP Code centroid movements in Florida including Franklin and Monroe counties and two new ZIP Code centroids.

G-4 Independence of Model Components

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

Audit

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

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

Verified: 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*

*(*New Standard)*

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

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2007*.

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

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

Verified: YES

Professional Team Comments:

Discussed with Kristen Estabrook her process for editorial review.

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

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 1, 2007 (or later), HURDAT as of June 1, 2005 plus the 2005 and 2006 seasons, or HURDAT as of June 1, 2006 plus the 2006 season. Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

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

Audit

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

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

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

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

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

Pre-Visit Letter

6. M-1, Disclosure 1, page 51 – NWS TPC-5 not included in references. Identify additional data from NWS TPC-5 not available from HURDAT.

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:

Verified that the June 2007 version of HURDAT for years 1900-2006 was incorporated for Florida and adjacent states. Discussed the process used to change from the Commission's previous Official Storm Set to HURDAT supplemented by landfall data from the NOAA Technical Memorandum NWS TPC-5. Discussed using NWS TPC-5 landfall data to supplement HURDAT 6 hour central pressure values.

Clarified that NWS TPC-5 has been included in references on page 20.

Reviewed comparisons of modeled probabilities with historical hurricane frequencies by segment and by region, as provided in Form M-1.

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

M-2 Hurricane Parameters and Characteristics*

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

7. M-2, Disclosure 1, page 53 – Identify the storms affected by data from NWS TPC-5, and identify if any other parameters were also adjusted due to this reference.

8. M-2, Disclosure 3, page 56 – Discuss the use of the Gradient Wind Reduction Factor on the NWS-23 windfield.

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 changes in storm catalog for 1900-1914 storms due to HURDAT reanalysis. Reviewed HURDAT supplementary U.S. landfall database.

Discussed that parameters for U.S. landfalling hurricanes from 1915 to 2006 were modified in agreement with data from NWS TPC-5. Reviewed the adjustments to central pressure in the AIR historical catalog due to use of NWS TPC-5 as a data source. Reviewed the differences in storms from the Commission's previous Official Storm Set. Verified that no other parameters were adjusted due to the NWS TPC-5 reference.

Reviewed updates to the distributions of central pressure for Florida segments 9-18.

Confirmed that historical storm Rmax values have been updated based upon HURDAT reanalyses and vortex statements. These data have yet to be incorporated into the stochastic storm distributions.

Discussed how bypassing storms are identified in the model.

Reviewed histogram of historical and modeled hurricanes by 100 mile coastal segment.

Reviewed changes in the hurricane parameters of annual frequency, landfall location, and central pressure in the event generation module.

Reviewed probability distributions for annual landfall frequency and intensity. Discussed the update to the annual landfall frequency and revisions to the probability distribution for landfall location.

Reviewed comparison of 2008 versus 2007 annual frequency distribution. Reviewed methodology for computing the negative binomial distribution and discussed the associated p-values.

Reviewed histograms and probability distributions at 50-mile coastal segments for landfall location.

Discussed changes by segment in the historical and simulated landfall frequency from last year to this year.

Reviewed histograms of simulated versus historical frequencies at 50-mile coastal segments.

Reviewed plot of landfall central pressure for all historical storms in Florida and adjoining states for 2007 and 2008.

Discussed the use of a gradient wind pressure relationship to compute winds at upper levels and the application of a factor of 0.9 (as recommended in NWS-23) to adjust the gradient winds to the surface, 10-minute 10-meter windspeed. AIR stated further research is underway in order to document the spatial variability of the gradient wind reduction factor.

Reviewed the spatial distribution of surface roughness. AIR stated they expect to have an updated land use land cover database incorporated next year.

Reviewed storm tracks that changed from 2007 to 2008 for storms due to the 1900-1914 reanalysis incorporation into HURDAT.

Reviewed spatial coverage of observed winds from dropsonde sites, onshore surface sites, and offshore surface sites for storms over North America and the Atlantic Ocean within 2003-2005. Discussed how these provide a potential source for future windfield validations.

Reviewed validation for wind observations comparing the existing model using NWS-23 and Willoughby. Discussed the effect of incorporating the three storm outliers in the strongest windspeeds resulting in improved correlations.

Reviewed the 50-mile coastal segmentation for Florida and how storms are treated for determining landfall location and intensity. Segments are based on data from NWS-23.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

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

Audit

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

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

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

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

Verified: YES

Professional Team Comments:

Reviewed animation of Hurricane Charley (2004) surface windfield as it crossed Florida.

Reviewed plots of historical versus simulated storm characteristics for 50-mile coast segments for Florida and adjacent states.

Discussed the method for selecting stochastic storm tracks.

M-4 Hurricane Windfield Structure*

*(*New Standard)*

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

B. The translation of land use and land cover or other source information to geographic surface roughness distribution shall be consistent with current state-of-the-science.

Audit

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

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

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

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

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

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

7. Form M-2 will be reviewed.

Pre-Visit Letter

9. M-4, Disclosure 1, page 63 – Discuss the applicability of the NWS-23 windfield with reference to the 25 years of storm data subsequent to the development of this windfield.

10. M-4, Disclosure 1, page 63 – Define “reasonable” in the context of windfield validation.

11. M-4, Disclosure 1, page 63 – Describe the mesa in Figure 6.

12. M-4, Disclosure 1, page 63 – Provide examples of wind radii corresponding to five different (Vmax, Rmax) combinations for both the largest and smallest shape parameter used for the stochastic storm windfield, demonstrating consistency of wind radii with Form M-3.

13. M-4, Disclosure 6, page 64 – Response provided is essentially unchanged from previous submission. Discuss the timeliness of the land use/land cover database.

14. M-4, Disclosure 8, page 65 – Provide examples of spatial windfield validation for Hurricanes Katrina and Wilma.

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 in detail the applicability of the NWS-23 windfield. Examined modeler analyses of historical storm windfields as represented in the model. Discussed variations around Rmax.

Discussed the mesa in Figure 6 on page 63.

Reviewed graphical representation of five different Rmax and Vmax combinations for a central pressure of 960 mb.

Discussed in detail the timeliness of the land use/land cover database. The National Land Cover Dataset has a vintage of 1992 but was not released until December 2000. AIR expects to have an update on this database next year. Discussed the methodology for updating the dataset and assigning values for the latest release which was in March 2007. Verified that adjustments are not made to the land use/land cover database for the model submitted.

Reviewed examples of spatial windfield validation for Hurricanes Katrina (2005) and Wilma (2005).

Reviewed Figure 12 provided in Form M-2. Discussed the spottiness or "hot spots" being due to having a very limited number of historical storms in those areas. Reviewed historical storm tracks and wind swaths for the panhandle.

Reviewed vortex statements in support of Rmax adjustments for Hurricane Earl (1998) and Hurricane Georges (1998).

Reviewed changes in radial profiles of rotating wind resulting from Rmax updates to Hurricane Earl (1998) and Hurricane Georges (1998).

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

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

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

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

Saffir-Simpson Hurricane Scale:

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

Audit

1. Describe the variation in over-land decay rates used in the model.
2. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.
3. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed.

Pre-Visit Letter

15. M-5.A, page 67 – Provide a detailed description of the method used to model the effects of land friction with explicit reference to only the relevant article(s).
16. M-5.A, page 67 – Provide a detailed description of the incorporation of the internal boundary layer into the calculation of damaging winds over land.

17. M-5, Disclosure 2, page 70 – Define "filling rate" as plotted in Figure 10 with reference to the equation at the top of the page.

18. M-5, Disclosure 2, page 70 – Provide examples of recent storms demonstrating that the overland filling rate model captures the time evolution of the storm decay for these independent cases.

19. M-5, Disclosure 3, page 71 – Provide a detailed description of the use of fetch and the associated realism of the modeled transition from water to land.

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:

Discussed in detail the method used to model the effects of land friction based on factors that are determined by surface roughness and the use of a gust scaling factor as depicted in Simiu and Scanlan (1996).

Discussed in detail the internal boundary layer. The basis wind is the gradient level wind using NWS-23 formulation, and winds are reduced to 10 meter by applying the 0.9 gradient wind reduction factor.

Reviewed transition of winds from over-water to over-land. Discussed the effect on maximum winds in relation to distance from coast.

Reviewed the calculation of the filling rate in Figure 10. Reviewed examples of actual versus modeled filling rates for Hurricanes Charley (2004), Frances (2004), Ivan (2004), Jeanne (2004), Dennis (2005), Katrina (2005), and Wilma (2005).

Discussed the use of the term fetch in model description.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

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

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

Pre-Visit Letter

20. Form M-3, page 79 – Do the Rmax values specified in the footnotes apply to all radii in the column?

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 in detail. Discussed Figure 14 showing the minimum, maximum, and median values.

Verified inclusion of radius bounds for quoted windspeeds for completion of Table 5.

Discussed reasons for lack of overlap and narrow radius ranges for weak storms.

VULNERABILITY STANDARDS – Fred Stolaski, Leader

V-1 Derivation of Vulnerability Functions

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

7. Form V-1 will be reviewed.

Pre-Visit Letter

21. V-1, Disclosure 2, page 84 – Discuss new insurance data received and analyzed.

22. V-1, Disclosure 5, page 91 – Provide examples of claims data indicating different performance of buildings built prior to 1995 and post-1994 as well as post-2001.

23. Form V-1, page 97 – Explain the increases in Estimated Damage compared to previous submission. Explain the incomplete sentence noted in the paragraph denoted by **.

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

Verified: YES

Professional Team Comments:

Discussed with Dr. Joseph Minor his independent peer review of the Vulnerability Standards, the Vulnerability Forms, and the vulnerability functions within the model. Reviewed his familiarity with appropriate building codes, literature, and post-hurricane inspection reports. Confirmed there are no outstanding issues from Dr. Minor's review.

Reviewed e-mail correspondence between AIR and Dr. Minor regarding questions arising during his review.

Discussed recent 2005 claims data received from two companies and the current phase in analyzing the data, which is not used in the current version of the model.

Reviewed examples of hurricane claims data from recent hurricanes for four companies indicating that buildings built after 1994 and 2001 perform better than pre-1995 buildings. Reviewed plots of observed mean damage ratio by year built.

Discussed Form V-1 and the increases in Estimated Damage from previous submission being due to a change in the type of data used for completing the Form.

Reviewed the application of duration and the calculation of damage at defined time intervals for Form V-1, Part A and Part B. Discussed magnitude of values for different construction types in Form V-1, Part B.

Reviewed graphs of damage ratio versus windspeed over time.

Reviewed graphs detailing the impact of duration on structures with mitigation measures included.

V-2 Mitigation Measures

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

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

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

Audit

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

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

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

Pre-Visit Letter

24. Form V-2, page 99 – Explain why in completing this form there is no need for a specified forward speed, whereas it was needed in completing Form V-1.

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:

Reviewed results provided in Form V-2 and Form V-3 (Trade Secret List).

Used values from Excel spreadsheet file of Form V-3 to generate and verify values in Form V-2. Discussed the absence of a duration effect on the values in Form V-2 and Form V-3 since it is not utilized in completing the Forms.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified model definition of landfalling hurricanes and by-passing storms.

A-2 Underwriting Assumptions

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

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

Audit

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

Verified: YES

Professional Team Comments:

Discussed methodology for reviewing claims payment practices of insurance companies.

Discussed that damage ratios represent insured losses rather than structural losses as the damage functions were developed using actual claim data.

A-3 Loss Cost Projections

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

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

Audit

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

Verified: YES

Professional Team Comments:

Verified 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 provision for economic inflation.

A-4 Demand Surge

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

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

Audit

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

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

Pre-Visit Letter

25. A-4, page 113 – Describe and provide examples of studies or analyses performed using data from 2004 or later storms to validate the AIR demand surge functions and calculations.

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 methodology for demand surge calculations from the previous year.

Reviewed updated studies on demand surge; examples included lumber costs and cumulative change of roofing labor costs since 2003.

Reviewed Xactware data screens.

Reviewed the extent of regions in Florida in the Xactware software package.

A-5 User Inputs

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

Audit

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

2. All insurer inputs and assumptions will be reviewed.

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

- A-5 – Client Data Processing Procedures

Information to be presented to the Professional Team:

- A-5.2, page 116 – A copy of the Preparer's Guide will be available to the Professional Team during its on-site visit.
- A-5.2, page 117 – A copy of the User's Guide will be available to the Professional Team during its on-site visit.

Verified: YES

Professional Team Comments:

Discussed the process for reviewing new data received from insurance companies. Reviewed how the new FHCF exposure data was processed. Reviewed software with risk count by policy. Reviewed series of reasonability checks on data.

Verified appropriate ingestion of FHCF exposure data for selected categories.

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

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

Reviewed Data Processing Checklist.

Discussed handling of roof shape data supplied in the FHCF exposure data. Discussed the process for validating and inputting data.

Reviewed input of FHCF exposure data file into the AIR model.

Reviewed computer code for reasonability checking of insurer data, including specific examples for validating construction type and occupancy.

Reviewed computer code for mapping construction types in the Industry Tech Guide used to map the FHCF exposure data into the model.

Reviewed computer code for mapping fields in FHCF exposure data with a zero risk count.

Verified appropriate ingestion of FHCF multiple exposures.

A-6 Logical Relationship to Risk

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

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

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

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

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

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

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

Audit

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

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

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

Pre-Visit Letter

28. Form A-3, pages 145-146 – Review Total Insured Losses ($) column.

Verified: YES

Professional Team Comments:

Verified totals for Form A-3. Reviewed list of storms that caused losses in Florida but made landfall in other states which accounts for the difference in insured losses given in Form A-3 and Form S-4.

Reviewed the process for completing Part A and Part B of Form A-5. Verified relationship of Figure 40 with Part A.

A-7 Deductibles and Policy Limits

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

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

2. Deductible loss costs shall be calculated in accordance with s. 627.701(5)(a), F.S.

Audit

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

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

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

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

Pre-Visit Letter

26. A-7, Disclosure 2, page 127 – Provide material cited.

Verified: YES

Professional Team Comments:

Verified no change in the process for calculating and applying deductibles and policy limits.

Documentation reviewed:

- Bhinderwala, S., "Insurance Loss Analysis of Single Family Dwellings Damaged in Hurricane Andrew," Master's Thesis, Clemson University, May 1995.

A-8 Contents

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

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Verified no change in handling contents losses.

Reviewed contents versus structure loss costs for frame and masonry.

A-9 Additional Living Expense (ALE)

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

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

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

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Reviewed results provided in Figure 34 and Figure 35.

Verified no change in the process and calculations used to develop ALE loss costs.

A-10 Output Ranges

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

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

1. masonry construction versus frame construction,

2. residential risk exposure versus mobile home risk exposure,

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

4. in general, northern counties versus southern counties.

Audit

1. Forms A-6A, A-6B, A-7, and A-8 will be reviewed.

2. The modeler will be required to justify all changes from the prior submission using the 2002 Florida Hurricane Catastrophe Fund aggregate exposure data.

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

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

Pre-Visit Letter

27. A-10, Disclosure 6, page 137 – Verify the exposure data used to complete Form A-6B.

Verified: YES

Professional Team Comments:

Reviewed individual changes in the model contributing to the changes in loss costs. Changes in loss costs greater than 10% were all driven by the changes in the storm catalog.

Reviewed Form A-7 and the increases in ALE. Reviewed relationships among ALE and other coverages.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no change in fitting process for landfall frequency by coastal segment.

Reviewed fits for updated central pressure at various landfall segments.

Reviewed small modifications to distribution parameters that resulted.

Reviewed Form S-1 changes from the previous submission. Discussed methodology for calculating the modeled probabilities.

Reviewed Form S-2 and 95% confidence intervals for PML. Discussed methodology for obtaining confidence limits.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Reviewed previous results of sensitivity studies for impact of central pressure and windspeed reduction factor for several counties.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

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

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 previous results of uncertainty studies for impact of central pressure and windspeed reduction factor for several counties.

S-4 County Level Aggregation

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

Audit

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

Pre-Visit Letter

29. S-4, Disclosure 1, page 308 – Prepare for review of convergence tests.

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 constrained sampling method used to obtain convergence and reduce sampling variability on loss costs by county.

Reviewed convergence graphs and comparisons of the loss costs based on various simulation durations.

S-5 Replication of Known Hurricane Losses

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

Audit

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

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

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

4. Form S-3 will be reviewed.

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

Verified: YES

Professional Team Comments:

Reviewed validation comparisons provided in Form S-3 and changes from the previous submission including the increases with Hurricane Georges (1998) in Table 19 and the removal of Hurricane Earl (1998) from Table 20.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-4 will be reviewed.

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

Verified: YES

Professional Team Comments:

Reviewed Form S-4 and reasons for large percentage change from previous year in Part A, including review of revised calculation.

Reviewed comparison of projected hurricane loss costs for historical and simulated events using confidence intervals showing reasonable agreement.

Verified consistency of specific results in Forms S-4 with Forms A-3 and A-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 modeler shall maintain a primary document binder, containing a complete set of documents specifying the model structure, detailed software description, and functionality. Development of each section shall be indicative of accepted software engineering practices.

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

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

Audit

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

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

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

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

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

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

7. Trace the model changes specified in Standard G-1, Disclosures 5 and 6 through all Computer Standards.

Information to be presented to the Professional Team:

- C-1.A, page 325 – The primary document binder set (11 binders total), which contains fully documented sections for each computer standard, shall be available for inspection by the Professional Team.
- C-1.B, page 325 – All computer software, data files, and databases are fully documented and such documentation shall be available for review by the Professional Team.
- C-1.C, page 325 – 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.

Verified: YES

Professional Team Comments:

Reviewed the following documentation:

- Primary Document Binder
- Enhancements and Document Mapping itemizing changes to the appropriate documents for the ZIP Code database update, the update to the historical catalog, and optimization to enhance model performance.

Reviewed CLASIC/2™ User Guide Version 9.0.

Reviewed UNICEDE®/px Data Exchange Format Preparer's Guide – Version 9.5.

Discussed the backward compatibility of model revisions.

Reviewed the table cross-listing Standard G-1 (Disclosures 5 and 6) with document and file references for affected components.

Discussed with Narges Pourghasemi her review of AIR's implementation of the model within the CLASIC/2™ software and compliance with the Computer Standards as well as current industry standard software engineering practices.

C-2 Requirements

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

Audit

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

Information to be presented to the Professional Team:

- C-2, page 326 – CLASIC/2 documentation specifying model requirements and computer implementation for each software component shall be available for verification by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the requirements binder containing:

- CLASIC/2™ Requirements Summary
- CLASIC/2™ User Interface – System Requirements and Specifications

C-3 Model Architecture and Component Design

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

Audit

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

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

Information to be presented to the Professional Team:

- C-3, page 327 – The component design document includes detailed control and data flow diagrams for event generation, and class diagrams for all other portions of the hurricane model and CLASIC/2 system. This document shall be available to the Professional Team during its site visit.

Verified: YES

Professional Team Comments:

Reviewed UNICEDE®/px Data Exchange Format – Preparer's Guide – Version 9.5 for formatting data used as an input to the model.

Reviewed the model architecture and component design binder containing:

- Event Generation Flowcharts
- CLASIC/2™ Business Overview
- CLASIC/2™ Architecture Overview
- CLASIC/2™ Presentation Layer
- CLASIC/2™ Business Layer
- CLASIC/2™ Common Services Layer
- CLASIC/2™ Loss Analysis Engine
- CLASIC/2™ Hazard Model Framework
- CLASIC/2™ Database System Overview
- CLASIC/2™ Database Reference Manual

C-4 Implementation

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

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

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

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

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

F. The modeler shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosures 5 and 6:

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

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

Audit

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

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

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

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

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

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

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

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

Verified: YES

Professional Team Comments:

Reviewed the coding guidelines.

Reviewed interaction with the Xactware web interface to obtain trend data used for calculating demand surge.

Reviewed the implementation and processing of the 2007 FHCF exposure database.

Reviewed the Excel formulas and data used to create the negative binomial distribution for annual hurricane frequency. Reviewed the method for incorporating revised distributions into code for stochastic storm generation.

Reviewed comment structures associated with code that processes the 2007 FHCF exposure data.

Reviewed SQL implementation for processing the 2007 FHCF exposure database.

Reviewed the C++ code to validate specific construction/occupancy combinations.

Reviewed code associated with annual landfall frequency.

Reviewed the formula and code to calculate windspeed.

Reviewed new code associated with updated landfall probability distributions. Discussed improvements to the code comments for identifying source of data feed from Excel.

Reviewed the query processing code in SQL used for handling exposure data with zero risk count.

Reviewed the documentation associated with the equations and formulas, and the cross-reference to the code.

Reviewed the implementation binder containing:

- Catalog generation code
- Fortran data files for catalog generation
- Physical properties generation code
- Fortran data files for generating U.S. physical properties
- ZIP centroid creation summary and verification
- ZIPAll creation
- Data files for ZIPAll creation
- HURSIM technical overview
- HURSIM data files
- Individual risk technical overview
- Data files for individual risk
- Loss data technical overview
- Data files for loss data
- Demand Surge validation and implementation
- Data files for validation and calculation of demand surge
- Model 21 technical overview
- Model 21 data files
- Model 21 2008 data files
- Model 21 development and implementation process
- Model 21 flowcharts
- Model 21 update classes
- Datafile converter
- Setting up a CLASIC/2™ developer's environment
- Building CLASIC/2™
- CLASIC/2™ Registry Settings
- Output Range reports – guidelines for preparation
- Model 21 equations/formulas and variable mapping
- Fortran catalog generation error codes
- Fortran physical properties error codes
- Fortran ZIPAll creation error codes
- Model 21 error codes
- Datafile converter error codes
- CLASIC/2™ engine errors and descriptions
- Fortran catalog generation line count
- Fortran physical properties line count
- Fortran ZIPAll line count
- Datafile converter line count
- CLASIC/2™ engine and Model 21 line counts
- Fortran coding guidelines
- C++/COM coding guidelines
- C#/.Net coding guidelines
- Technical documentation guidelines

C-5 Verification

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

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

Pre-Visit Letter

30. C-5.A, page 333 – Provide a statement to the effect that verification tests have been performed by modeler personnel other than the original component developers *for each* component.

Information to be presented to the Professional Team:

- C-5.A, page 333 – 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 during the site visit.
- C-5.B, page 334 – Materials that demonstrate SQA processes shall be available to the Professional Team for review during their site visit.

Verified: YES

Professional Team Comments:

Reviewed SQL code associated with quality assurance methods for the 2007 FHCF exposure database.

Reviewed the Processing Checklist, which includes the Project Name, Associate Name, and Peer Reviewer.

Reviewed the Project Information Assumption Form (PIAF) associated with verifying insurer input data.

Reviewed the verification binder containing:

- Catalog generation code testing
- Physical properties generation code testing
- Individual risk testing
- Loss data testing
- Model 21 testing for CLASIC/2™
- Model 21 basic and final QA test cases
- Unit testing of Model 21 in CLASIC/2™
- Datafile converter testing
- CLASIC/2™ QA test tools
- CLASIC/2™ code verification
- CLASIC/2™ functional test plan
- CLASIC/2™ test classifications
- Analysis classification tests
- Exposure classification tests
- Installation classification tests
- Output classification tests
- Performance classification tests
- Output range tests
- Percent change by county
- Model 21 surge plots

- Model 21 wind plots
- Construction occupancy
- Age Height
- Mitigation
- Output Range Reports A-6A
- Output Range Reports A-6B
- Average annual loss comparison
- Loss cost – storm surge
- Loss cost – wind SS

Discussed process for cross-verifying information calculated in Excel prior to input into the model code.

Discussed the use of parallel research and operational codes for upgrade verification.

C-6 Model Maintenance and Revision

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

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

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

Audit

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

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

Information to be presented to the Professional Team:

- C-6.1, page 336 – We are prepared to demonstrate these systems and methodologies during the Professional Team's site visit.

Verified: YES

Professional Team Comments:

Reviewed the policy for model revision.

Reviewed the model maintenance and revision binder containing:

- Model and software revisions and versioning
- Model and software change control process
- AIR data control workbook
- AIR documentation control process

C-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed the security binder containing the AIR code, data and documentation security policy.