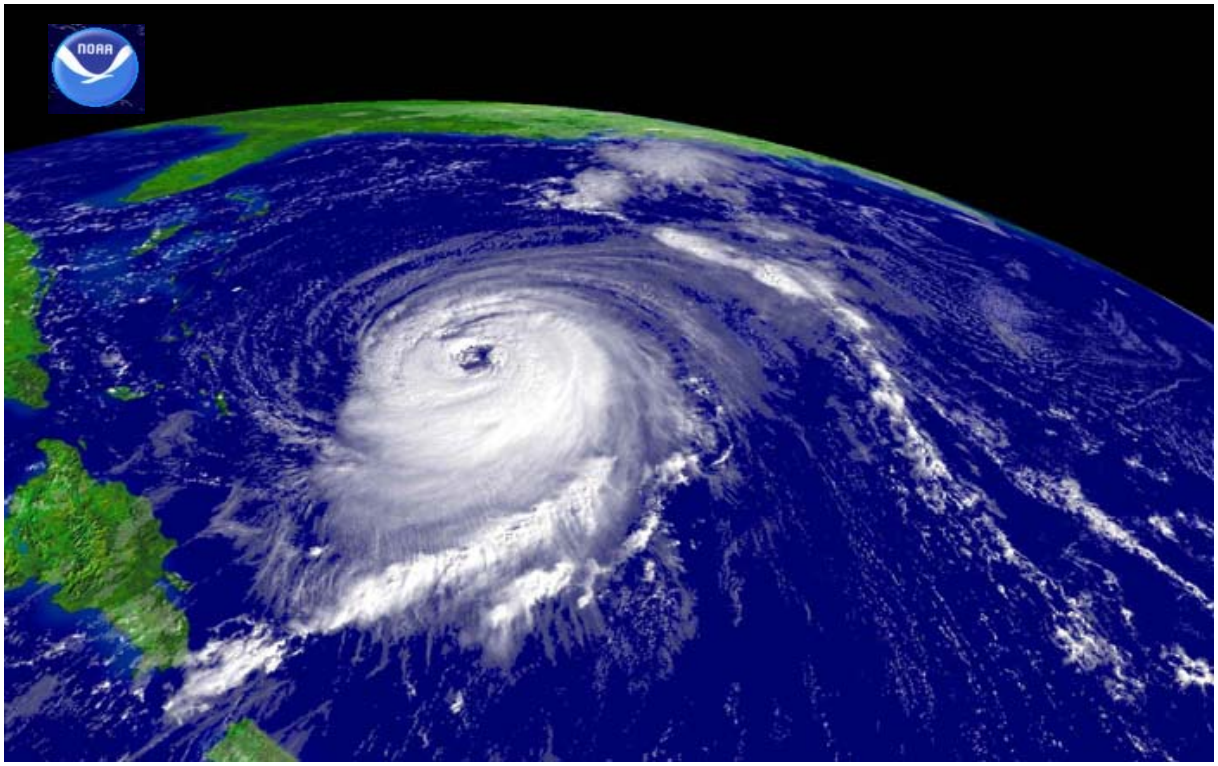
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2003 Standards

AIR Worldwide Corporation

On-Site Review
April 12 – 14, 2004

Additional Verification Review
May 5, 2004

On April 12 – 14, 2004 the Professional Team visited on-site at AIR Worldwide Corporation in Boston, Massachusetts. The following individuals participated in the review.

AIR

Bhaskar Chattaraj, Manager, Quality Assurance
Peter S. Dailey, Ph.D., Manager, Atmospheric Science
Boris Davidson, Technical Manager, Chief Software Architect
Michele D. Fischer, Research Scientist, Meteorology
Jayanta Guin, Ph.D., Vice President, Research and Modeling
Atul C. Khanduri, Ph.D., Manager, Wind Risk Modeling
David Lalonde, FCAS, FCIA, MAAA, Senior Vice President
S. Ming Lee, Senior Vice President
Greta M. Ljung, Ph.D., Senior Research Statistician
Shangyao Nong, Ph.D., Senior Research Scientist, Meteorology
Mohit Pande, Research Engineer
Miriam E. Perkins, ACAS, MAAA, Actuarial Analyst
David Richards, Assistant Vice President and Director, Software Development Group
Larry Trudeau, Software Engineer Manager, Software Development Group

Professional Team

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

The review began with introductions and an overview of the audit process. AIR began with a discussion of the changes to the model from the previous year which include:

- ZIP Code database update
- Historical catalog update through 2002
- Revised approach to generating hurricane tracks
- Refined methodology for estimating the impact of land-use and land-cover
- Updates to the apartment and condominium vulnerability functions.

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

AIR gave a detailed presentation on the new Atlantic base track generation methodology and the updates to their apartment and condominium vulnerability functions. Discussed in detail the impact of these changes on the model.

Discussed and reviewed corrections to be made in the submission that will be provided to the Commission prior to the May 12 & 13, 2004 meetings.

- Page 28, Professional Credentials for Software Development Personnel (Dave Richards, Boris Davidson, Bhaskar Chattaraj, and Chris Lehner)

- Page 57, Figure 7 correction to vertical axis labeling
- Pages 132-133, Revised Figures 33 and 34 to correspond to data provided in Table 15
- Page 134, correction in formula provided in response to Disclosure #1
- Page 225, Form S-5 correction to number provided under *Second Prior Produced by Model*
- Page 232, Form S-11 correction to numbers provided in Part B

At the completion of the on-site review, several standards could not be verified, as detailed in the subsequent report.

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Additional Verification Review – May 5, 2004

AIR Worldwide Corporation (AIR) submitted corrections to the AIR model submission under the 2003 standards on April 29, 2004. The majority of the revisions were related to the following two issues:

1) At the April 12-14, 2004 on-site review, a substantial decrease in Franklin County output ranges was attributed to a change in the ZIP Code population centroid. Upon further examination, it was determined that the third party supplier of GIS data had the provision that a computed ZIP Code centroid over water is superseded by the geographic centroid, in violation of Standard G-4. This issue of ZIP Code centroids was further investigated by AIR prior to the additional on-site verification review.

   To summarize, various provisions in the GIS centroid supplier product resulted in impacting 21 ZIP Codes across 16 counties. A handful of these involved the aforementioned case of a population centroid over water. However, this was not the only case discovered. For example, irregularly shaped ZIP Codes can produce a population centroid outside the ZIP Code boundary. In this case, the supplier again reverts to a geographic centroid. Each of the 21 cases was reviewed by the subset of the Professional Team for assessment of AIR's analysis of each. The ZIP Code centroids now used are population centroids. It has also been demonstrated that these are the only ZIP Codes affected.

   Review of the process for handling ZIP Code data is discussed under Standard G-4. Following the resolution of the ZIP Code centroid issue, in principle, the Professional Team subset proceeded to determine that the revised centroids had been introduced in the data bases supporting the calculations of the output ranges. Finally, the Professional Team subset considered changes to the various Forms, figures, and tables potentially impacted by the revised ZIP Codes. These impacts are considered as appropriate into the Standards review.

2) The method of calculating ALE loss did not properly take into account the number of risk count exposures. A correction has been made to appropriately apply ALE loss to risk count data by coverage. This was verified through consideration of several ZIP Codes and their FHCF exposures.

The Professional Team subset completed the additional on-site verification review on May 5, 2004. **All Standards are now verified.**

The following participated in the additional verification review:

AIR

Peter S. Dailey, Ph.D., Manager, Atmospheric Science
Jayanta Guin, Ph.D., Vice President, Research and Modeling
Atul C. Khanduri, Ph.D., Manager, Wind Risk Modeling
David Lalonde, FCAS, FCIA, MAAA, Senior Vice President
Mohit Pande, Research Engineer
Miriam E. Perkins, ACAS, MAAA, Actuarial Analyst
John Rowe, Exposures Manager

Professional Team

Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Anne Bert, Staff

Deficiencies from March 18, 2004 Meeting

1. G-2.2.D (page 36/37) – incomplete response (indicate specifically whether the individuals are associated with the insurance industry, consumer advocacy group, or a government entity as well as their consulting activities).

   AIR Response – Additional information provided.

   Verified: Yes

2. G-2.4 (page 38) – page number provided incorrect.

   AIR Response – Page number has been corrected.

   Verified: Yes

3. M-4.1 (page 54) – old module reference provided in response.

   AIR Response – Reference has been corrected.

   Verified: Yes

4. M-4.4 (page 58) – page number provided incorrect.

   AIR Response – Page number has been corrected.

   Verified: Yes

5. V-2.A (page 85) – reference to Attachment J incorrect.

   AIR Response – Reference has been corrected.

   Verified: Yes

6. V-2.B (page 85) – reference to Attachment F incorrect.

   AIR Response – Reference has been corrected.

   Verified: Yes

7. A-3.1 (page 98) – old module references provided in response.

   AIR Response – Reference has been corrected.

   Verified: Yes

8. A-4 (page 100) – old Form B reference in Table 8.

   AIR Response – Reference has been corrected.

   Verified: Yes

9. A-6.2 (page 109) – old Form B reference in Table 10.

   AIR Response – Reference has been corrected.

   Verified: Yes

10. A-7 (page 110) – old Form B reference in Table 11.

    AIR Response – Reference has been corrected.

    Verified: Yes

11. S-1.6 (page 120) – page number missing in response.

    AIR Response – Page number has been provided.

    Verified: Yes

12. S-1.7 (page 120) – page number missing in response.

    AIR Response – Page number has been provided.

    Verified: Yes

13. S-5.3 (page 133) – page number missing in response.

    AIR Response – Page number has been provided.

    Verified: Yes

14. S-6.5 (page 136) – page number missing in response.

    AIR Response – Page number has been provided.

    Verified: Yes

15. S-6.6 (page 136) – page number missing in response.

    AIR Response – Page number has been provided.

    Verified: Yes

16. S-7.7 (page 140) – page number missing in response.

    AIR Response – Page number has been provided.

    Verified: Yes

17. Form S-1B (page 185) – Personal Residential Owners Frame is S-1A (98 exposure) for pages 185-189 rather than S-1B (02 exposure).

    AIR Response – The header on these pages was incorrect, it has been changed to read Form S-1B. The exposure used for weights was in fact the 02 exposure. This can be seen by comparing the weighted average loss costs on pages 185-189 to those on pages 145-149 of the submission.

    Verified: Yes

18. Form S-9.A (page 230) – response not provided.

    AIR Response – The response was inadvertently omitted. It has been provided on the revised page.

    Verified: Yes

AIR addressed all issues in the deficiency letter to the satisfaction of the Professional Team.

AIR Worldwide Corporation – 2003 Pre-Visit Letter

The main purpose of the on-site review performed by the Professional Team (Pro Team) of the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) is to verify that the written and electronic submission conforms to the model producing the output ranges included in the submission to the FCHLPM. It is particularly important to review in detail all information relating to the model, including any information that may be considered proprietary. Be prepared to respond to questions and requests for material as outlined in the Audit section under each Standard. It is the responsibility of the modeler to provide all information necessary for a complete review of the model.

For each reference within the submission that cites "material will be shown to the professional team," it is important that the material is presented to the Pro Team during the on-site review. Material that the modeler intends to present to the FCHLPM should also be presented to the Pro Team during the on-site review.

All aspects of the computer software will be reviewed including software either developed off-site or contracted out. Spot checks will occur during the review process, and all relevant personnel for the software being reviewed will need to be present when called upon. If software component authors are not present during the on-site review, the modeler shall have proxies for those components.

In the course of preparing for the on-site review, the Pro Team has identified some specific areas and questions that it intends to cover while on-site. These items are provided below to assist the modeler in preparing for the on-site review. Some of this material may have been shown or available on a previous visit by the Pro Team. The Pro Team will also be considering material in response to the Commission's designation(s) of omissions or responses deemed non-responsive.

The goal of the Pro Team is to provide the FCHLPM with a clear and thorough report of the model, subject to non-disclosure conditions. All modifications, adjustments, assumptions, or other criteria that were included in producing the information requested by the FCHLPM 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 Pro Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Pro Team. The Pro Team should be provided access to a phone line that can provide internet access through one of the Pro Team member computers for reference work that may be required while on-site.

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

General Standards

1. **G1.2** (page 17-18), Event Generation Component – When doing stochastic sampling to create the event set, to what extent are track and intensity time series linked?
2. **G1.2** (page 17-18), Event Generation Component – Provide justification of the coastline and frequency smoothing distance of 500 miles from a statistical and physical basis.
3. **G1.2** (page 19), Wind Field Generation Component – Which wind field are you using exactly?
4. **G2.1** (page 26) – Describe any involvement of ISO in the analyses, reviews or revisions to the model.
5. **G2.2A** (page 29) – Provide Peter Dailey's resume and other new employees involved in model.
6. **G2.2A** (page 35) – Provide *Years of Modeling Experience* for *5. Computer Science* personnel.
7. **G2.2C** (page 36) – Provide names for personnel involved in Figure 4.
8. **G4** (page 41) – Damage starts from one-minute sustained winds but also involves duration. What role exactly does duration play? How is it handled in the computer code? What conversions are relevant (refer to #3 above)?

Meteorological Standards

9. **M2.2** (page 46-47) – Rmax is indicated "as described above". Where in the submission is it previously described?
10. **M2.2** (page 47) – How is the air density coefficient incorporated into the model? What, if any, is its relationship to SST or to K $\left(= \left(\frac{1}{\rho e} \right)^{\frac{1}{2}} \right)$ as in NWS #23?
11. **M2.3** (page 47) – Be prepared to discuss the method for 10-minute to 1-minute conversion as based on NWS #23.
12. **M2.3** (page 47) – The submission states, "AIR reduction factor value is consistent with current understanding of the relationship between gradient wind and surface wind." Specifically, how is this understanding based on high resolution GPS sondes? How does AIR incorporate this recent data in understanding and in deriving their surface winds? Be prepared to show this work to the Pro Team during the on-site review.
13. **M2.4** (page 48) – How is β measured (clockwise or counterclockwise from the track)? Verify the measurement with the vortex asymmetries produced in the model.
14. **M2.5** (page 48) – Provide details on historical starting locations.
15. **M3.2** (page 52) – Is the Cat 5 maximum modeled wind derived consistent with observations over Florida? Should we expect to see the upper limits 95 and 155 show up in the simulations?
16. **M4.3** (page 57) – Explain title and legends of Figure 7.
17. **M5** (page 59-61) – Be prepared to discuss the friction factor and its relation to current wind speed to give future (reduced) wind speed. Further, how does it relate to $Adjfac_h$?
18. **M5** (page 60), Figure 8 – Does the wind bin size of 115-145 prevent observing additional structure?
19. **M5.1** (page 61) – In the calculation of storm weakening over land, at what time does V represent the wind speed? How do the coefficients a and b depend on the coastal segment?

20. **M5.1** (page 61) – Having justified using time from landfall, rather than distance, to calculate frictional spin down over land for storms moving at different forward speeds, a dependence on distance from the coast is also asserted (although a mathematical relation is not provided). How does the frictional spin down relate to distance from the coast and how does this differ from the time dependence?
21. **M5.4** (page 62) – Be prepared to discuss the rapid over-weakening of the storm by the model in the first couple of hours after landfall.
22. **Form M1** (page 64) – The Official Storm Set includes the updated Hurricane Andrew data. This is not evident in the simulated storm frequencies.
23. **Form M3** (page 67-68) – Provide explanation for extra red in Florida Bay that is somewhat surrounded by pink areas.

Vulnerability Standards

24. **V1.1** (page 75), Figure 12 – There is no direct connection between the Detailed Claims and Loss Data box with the Vulnerability Functions box. Is the development of the vulnerability functions claims based?
25. **V1.2** (page 75) – Provide any insurance data obtained since the prior review of your model by the FCHLPM.
26. **V1.2** (page 76-77) – Provide horizontal axes labels. There appears to be two bands of red curves in Figure 15 especially.
27. **V1.3** (page 79) – How exactly did the validation for Georges take place?
28. **V1.4** (page 80-81) – Highlight the key references used in the development of the vulnerability functions.
29. **V1.5** (page 82) – States construction types and vulnerability functions are unique for residential and apartments or condominium buildings. Be prepared to discuss why impact of Mitigation Measures (Form V-2) is the same for all.
30. **V1.5** (page 83) – Be prepared to discuss damage functions for height ranges of apartment/condominium structures.
31. **Form V-1** (page 87) – Which historical storm was used? What was the corresponding forward speed?
32. **Form V-1** (page 87) – For future submissions we anticipate a revision to Form V-1 with higher wind speeds and the addition of mitigated frame and masonry structure. Do you have any comments?
33. **Form V-2** (page 90) – Results of the runs at the various wind speeds for individual mitigation measures should be available and selected examples will be reviewed. Be prepared to discuss changes in instructions such as choice of required ZIP Codes, range of wind speed, list of required mitigation measures, use of "Renters" and "Condo Unit Owners" sections, weighted average, change in damage at specific wind speeds rather than a range, adding structures with specific combinations of mitigation measures, etc.
34. **Form V-2** (page 90) – Provide an explanation for the base structure used for the additional mitigation factors along with a definition of "Owners Frame" use in the "unnamed" table added to the Form V-2 Output.

Actuarial Standards

35. **A1.1** (page 91) – Be more specific, "within 72 hours" of what?
36. **A1.3** (page 92) – Describe in greater detail how storm surge damage to the infrastructure is considered in the model. Verify that storm surge option is off.
37. **A1.7** (page 94) – Based on your response, describe whether Loss Adjustment Expenses are "implicitly" included in the model.
38. **A3.2** (page 98) – Provide any insurance data obtained since the prior review of your model by the FCHLPM. Should some of the material from the Preparer's Guide be provided to the FCHLPM?
39. **A4.4** (page 105) – What is meant by "adjacent ZIP Codes are generally within one range of average loss costs?"
40. **A5.2** (page 107) – How does the Rubenstein reference relate to Table 9?
41. **A6.1** (page 109), Figure 27 – Provide interpretation for plot as correspondence looks very weak.
42. **A7** (page 110), Figure 28 – What is the x-axis?
43. **A7.2** (page 111) – Be prepared to explain the relationship in Figure 29 as compared to the relationship in Figure 27.
44. **Form A-1** (page 112) – Be prepared to discuss the decrease in the maximum wind speeds and the relatively higher decreases in the losses. Also, explain why the maximum winds for category 5 are all less than 150mph and some of the maximum winds for category 4 storms are less than 130mph.

Statistical Standards

45. **S2.3** (page 122) – Provide explanation for "one standard error".
46. **S2.5** (page 123) – Provide results of sensitivity analysis for review by the Pro Team.
47. **S3.5** (page 125) – In what sense is the negative binomial more general than the Poisson?
48. **S5.2** (page 132-133) – Provide interpretation for Figures 33 and 34.
49. **S6.1** (page 134) – Provide explanation for x in sample size equation.
50. **S6.3** (page 135) – Provide justification for increase in numbers from previous year submission.
51. **Form S-1B** (page 210-219) – Be prepared to explain 0.0000 values for weighted averages.
52. **Form S-2** (page 221) – Be prepared to show documentation justifying changes in loss costs for the individual counties listed in Table 18 (page 138), especially Franklin County. Emphasis will be placed on the revision of the Renters and Condominium vulnerability functions. Why were other counties not impacted by the LU/LC change?
53. **Form S-5** (page 225) – Provide explanation for value of 1.138 given for *Second Prior, 1998 FHCF Data, Produced by Model*.
54. **Form S-8** (page 229) – Provide Hurricane Andrew losses in current dollars.
55. **Form S-11** (page 232) – Provide explanation for the numbers given in part B.

Computer Standards

56. **C1.C** (page 233) – Provide justification for meeting this standard.

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

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

Verified: YES

Professional Team Comments:

Discussed the intensity variation along tracks and how it is represented using time series methods.

Discussed the references used for the smoothing formula and how adjustments are made to the formula.

Reviewed the wind field formula used which is based on NWS-23.

G-2 Qualifications of Modeler Personnel and Independent Experts

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

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

Audit

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

The Professional Team will review Form G-1 and all independent peer reviews of the model.

Discuss any incidents where model personnel have failed to abide by the standards of professional conduct adopted by their profession.

Verified: YES

Professional Team Comments:

*****Initial Review Comments*****

Discussed ISO's involvement as a client and as a model reviewer. ISO uses the AIR model for loss cost filings. Insurance industry data collected by ISO is used for model validation purposes.

Reviewed resumes of modeler personnel:

- Peter S. Dailey, Ph.D., Meteorology, University of California, Los Angeles
- Michele D. Fischer, M.S. Meteorology, The Pennsylvania State University
- Atul Khanduri, Ph.D., Concordia University, Montreal, Canada.

Reviewed personnel involved in aspects of the model as documented in Figure 4, *AIR Hurricane Model Workflow* (page 36).

Discussed personnel turnover since last visit.

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

Reviewed resumes of modeler personnel:

John Rowe, Exposure Manager

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

Provide geographic displays for selected ZIP Codes. The Professional Team will review the location of specific centroids.

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

Professional Team Comments:

*****Initial Review Comments*****

Selected five ZIP Codes affected by Hurricane Andrew (33122, 33158, 33170, 33179, 33180) and reviewed the modeled maximum wind speeds, the modeled exposures, and the modeled losses.

Reviewed maps of population weighted ZIP Code centroids for several counties showing the effect of centroid updates on loss costs.

Anomalies in the ZIP Code centroid database were discovered. If a population centroid is located over water, the package reverts to the geographic centroid for that ZIP Code.

Verification of this standard will require a written verification process to be used by the modeler for future ZIP Code verifications.

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

Reviewed document related to U.S. zip code update process entitled: “U.S. Exposure Update-Preparation of Centroid related Files”.

Reviewed maps and tables showing centroid revisions from the original submission for all 21 zip codes affected.

G-4 Units of Measurement

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

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

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

Audit

The Professional Team will review the model to assess the appropriateness and accuracy of the measurements, conversion factors, and techniques.

Verified: YES

Professional Team Comments:

Discussed storm duration, how damage is calculated, and how total damage is accumulated. Reviewed computer code showing how damage is calculated.

Appropriate units of measurement were verified throughout the review process.

G-5 Independence of Model Components

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

Audit

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 storm.

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

Verified: YES

Professional Team Comments:

Item (1) of the audit was addressed in the context of the Meteorology, Actuarial, and Vulnerability, and there was no evidence uncovered to suggest dependence of components.

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Official Hurricane Set*

*(*Significant Revision)*

For landfall frequency analyses, the modeler shall use the latest updated Official Storm Set. Updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to the storm set.

Audit

The modeler will provide the storm set used. Failure to update the storm set, as specified in the Standard, is not acceptable.

Verified: YES

Professional Team Comments:

Verified that AIR updated the stochastic storm set for 2002. Reviewed historical storm frequency by region, as well as the percentage change in loss cost by county as a result of this update.

M-2 Hurricane Characteristics*

*(*Significant Revision)*

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

Audit

Prepare graphical depictions (e.g., histograms overlaid with fitted density functions) of storm characteristics as used in the model. Describe:

- the data set basis for the fitted distributions,
- the assessments of correlated characteristics (e.g., central pressure and radius of maximum winds),
- the fitting methods used and any smoothing techniques employed, and defend the choices of distributions used,
- the spatial distribution of hurricane force winds associated with both modeled and historical events.

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

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

The Professional Team will compare the treatment of uncertainties associated with the conversion of gradient winds to surface winds with currently accepted literature.

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

Verified: YES

Professional Team Comments:

Discussed how the air density coefficient is incorporated in the model. Discussed relationship between air density coefficient and sea surface temperature.

Reviewed AIR's method for converting gradient wind speeds to 10-meter 1-minute sustained winds over land.

Reviewed time-based contour animations of the wind field for a slow and a fast moving storm verifying the asymmetric nature of hurricanes as well as other wind field characteristics in the model.

Reviewed plots of starting locations for historical storms in the stochastic storm set.

Reviewed the following references:

- Simulation of Hurricane Risk in the U.S. Using Empirical Track Model by P.J. Vickery, P.F. Skerlj, and L.A. Twisdale, *Journal of Structural Engineering*, October 2000, pages 1222-1237.
- Stochastic Modeling of Western North Pacific Typhoons for Japanese Property Insurance Loss Estimation by Vivek Pawale, Jianming Yin, and John Rowe, Proc. Eleventh International Conference on Wind Engineering, Lubbock, Texas, June 2-5,2003.

Reviewed comparison of historical and simulated tracks, Form M-1, and discussed the changes from the previous year.

M-3 Landfall Intensity

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

Saffir-Simpson Hurricane Scale (for displayed parameters):

Category	Winds (mph)	Central Pressure (mb)	Damage
1	74 - 95	$\geq$ 980	Minimal
2	96 - 110	965 - 979	Moderate
3	111 - 130	945 - 964	Extensive
4	131 - 155	920 - 944	Extreme
5	Over 155	< 920	Catastrophic

Audit

Demonstrate the goodness-of-fit of the frequency distributions of category 3-5 hurricanes.

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

Verified: YES

Professional Team Comments:

Reviewed frequency distributions of all hurricane categories for Florida regions and other relevant locations.

Reviewed methods for determining intensity at landfall.

Reviewed upper wind limits in simulated storm set.

M-4 Hurricane Probabilities

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

B. Modeled hurricane probabilities shall reasonably reflect the historical record through 2002 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

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

Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.
Describe and support the method of selecting stochastic storm tracks and angles of landfall.

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.

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

Verified: YES

Professional Team Comments:

Figure 7 compares the historical and simulated central pressure distributions by 100-mile coastal segment for Florida and adjacent states. The values on the vertical axis represent the number of historical values for the 1900-2002 period. The simulated values are normalized to represent occurrences over a corresponding 103-year period.

Verified presence of Hurricane Andrew in historical storm set, not evident due to rounding.

Reviewed regional charts verifying the validation of U.S. landfalls by storm formation, the matching of simulated tracks to historical, and the blending of tracks for by-passing storms.

M-5 Land Friction and Weakening*

A. *The magnitude of land friction coefficients shall be consistent with currently accepted scientific literature, consistent with geographic surface roughness, and implemented with appropriate geographic information system data.
*(*Significant Revision)*

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

Audit

Justify the collection and publication dates of the land use and land cover data used in the model.

Maps depicting land friction effects are required. Describe the representation of land friction effects in the model.

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

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

Verified: YES

Professional Team Comments:

Collection and publication dates of land use/land cover data were reviewed.

Discussed the land-use and land-cover data used in the model. Reviewed graphical representations of the local computation of roughness and surface friction factors and the formula used for calculations based on accepted scientific literature – Simiu and Scanlan, Cook, and ESDU.

Discussed how the friction factor is calculated and the different factors taken into account. Reviewed the calculation for land friction and weakening and use of $Adjfac_h$ (pages 59-61).

Reviewed curves showing the over-land weakening of storms by the model for a number of hours after landfall.

Discussed how the gradient level winds are adjusted for friction.

Discussed how distance from the coast is taken into account when calculating the over-land weakening rate and their techniques for smoothing.

Verified that V represented landfall windspeed. Verified regional variation of a and b. Reviewed code.

Verified dependence of surface winds on both time and distance from landfall.

Reviewed rapid overland weakening in the context of this model. Reviewed code relevant to this component.

M-6 Logical Relationships of Hurricane Characteristics

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

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

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

Audit

Forms M-2, M-3, and the modeler's sensitivity analyses provide the information used in auditing this Standard.

Verified: YES

Professional Team Comments:

Discussed Form M3 – coloration in Florida Bay caused by spill over of ZIP Code and due to mapping software.

Reviewed scatter plot of radius of maximum winds versus intensity for simulated storms.

Reviewed simulations of storm asymmetry for varying translation speeds.

Reviewed surface wind speed variation with roughness.

VULNERABILITY STANDARDS – Fred Stolaski, Leader

V-1 Derivation of Vulnerability Functions*

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

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

Form V-1 will be reviewed.

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

Professional Team Comments:

*****Initial Review Comments*****

Reviewed the methodology for the development of vulnerability functions. New data from Georges has been added.

Reviewed and discussed new insurance claims data obtained from Hurricane Georges (1998) since the prior review of the model. Discussed the validation of the new data from Georges.

Discussed new expert opinion on the apartments and condominium vulnerability functions. No changes were made to the vulnerability functions due to the new data.

Discussed the basis for vulnerability functions and how claims and loss data is used and ties into the development of the vulnerability functions. (Figure 12)

Reviewed actual and simulated damage ratios versus wind speed charts provided in Figures 13-18 and discussed the generation of the curves.

Discussed the key references used in the development of the vulnerability functions.

Discussed mitigation measures relative to residential, apartment, and condominium buildings.

Discussed the vulnerability functions for different height ranges of apartment and condominium buildings.

Viewed presentation of the effect of storm duration and how the resulting cumulative damage to the structure is dealt with over the life of the hurricane.

Discussed addition of a “feedback” loop to Flow Diagram (Figure 12) to visually show how differences between engineering calculations and insurance data are reconciled.

Looked at standardized forms and procedures set up for engineers to perform field inspections of hurricane damage. Saw actual field diary used to document hurricane damage during a field inspection.

Reference paper added to required list of documents used in the development of the model’s vulnerability functions was reviewed, ”Catastrophe Modeling and Windstorm Loss Mitigation” by Atul Khanduri, Proc. Eleventh International Conference on Wind Engineering, Lubbock, Texas, June 2-5, 2003.

Viewed presentation on the effect on damage functions of variations in height for apartment and condominium structures. Modeler then showed spreadsheet listing various types of building occupancy, construction material, and building height which would affect the vulnerability of the structure. Examined development of factors for different combinations of these variables and overall factors to be used in the development of vulnerability functions for apartment/condominium structures. The work was independently peer reviewed by three outside consultants who developed separate overall factors for the vulnerability functions. The results of the peer review were compared with the original work and the reconciliation of the differences was discussed.

Reviewed Form V-1 with special emphasis on the use of a range for the damage calculations to account for the Modelers requirement of a complete time profile of one minute sustained wind speeds. This range was accomplished through the use of a historical storm at two different forward speeds in order to show the effect of storm duration. Base structures as required by Form V-1 were used and identity plus forward speed of historical storm used was disclosed.

Verification pending review of Form V-1 to be revised and presented to the Professional Team.

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

Reviewed resubmitted Form V-1. Discussed estimated damages that changed for specific wind speeds. Reviewed wind speed chart with wind speed bands on the x-axis. Reviewed footnote and recommended additional change relative to definition of estimated damage.

V-2 Mitigation Measures*

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

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

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

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

Audit

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

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

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.

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

Professional Team Comments:

*****Initial Review Comments*****

Discussed the use of multiple mitigation factors and the process they use to ensure no double credits.

All required mitigation measures reported in Form V-2 were completed with the maximum and minimum calculated values of percent change in damage and found to be reasonable.

Additional Form V-2 mitigation factors beyond those required were reviewed and found to be theoretically sound and reasonable. They were based on the same wood frame base structure detailed for use in Form V-2.

Several examples of values listed for specifically selected mitigation factors were discussed in depth.

Refinements to Form V-2 such as increased resolution of wind speeds and addition of new base structures with specific combinations of mitigation measures were discussed.

Reviewed spreadsheets with raw data for Form V-2, including mapping of mitigation measures to model categories and description of base structure used. Also reviewed computer runs at a higher wind speed resolution than required giving the required change in damage due to an individual mitigation measure.

Verification pending review of Form V-2 to be revised and presented to the Professional Team.

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

Changes to the model since initial on-site review did not impact Form V-2.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Underwriting Assumptions

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

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

Audit

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

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:

Reviewed responses to pre-visit letter questions.

Discussed in detail how the AIR model considers storm surge damage to the infrastructure. Verified that storm surge option was turned off when producing the loss costs in the output ranges.

Discussed model exclusion of Loss Adjustment Expense in loss cost derivations.

A-2 Loss Cost Projections

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

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed how comparisons are considered in light of demand surge.

A-3 User Inputs

All modifications, adjustments, assumptions, defaults, and treatments of missing values used in the model shall be actuarially sound and included with the model output.

Audit

All insurer inputs and assumptions will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed work papers on assumptions and the following documentation:

- Preparer's Guide
- User's Guide

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

A-4 Logical Relationship to Risk

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

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

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

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

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

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

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

H. The relationship of loss costs for individual coverages (A, B, C, D) shall be consistent with the coverages provided.

Audit

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

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

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

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

Professional Team Comments:

*****Initial Review Comments*****

Discussed in detail wind speed decreases.

Discussed in detail decreases in losses for several ZIP Codes – required amendments to modeler's submission.

Discussed Form A-1 wind speeds.

Explanations accepted for Category 4 and 5 storms and corresponding wind speeds on Form A-1.

Inconsistencies relative to losses by coverage to be addressed and reviewed by the Professional Team.

Verification pending review of Forms A-1 and A-2 to be revised and presented to the Professional Team.

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

Reviewed revisions to Form A-1. Changes are consistent with explanation of ZIP Code and ALE issues described on page 2.

Reviewed all changes in revised Form A-2 submission from initial Form A-2 submission and verified that each non-zero change was consistent with ZIP Code centroid movements.

A-5 Deductibles and Policy Limits

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

B. The relationship among the modeled deductible loss costs shall be reasonable. Differences in these relationships from those previously found acceptable shall be reasonable.

Audit

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

Verified: YES

Professional Team Comments:

Modeler removed inappropriate Rubenstein reference. Deductible and policy limit material unchanged from prior submissions.

A-6 Contents

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

B. The relationship between the modeled building and contents loss costs shall be reasonable, based on the relationship between historical building and contents losses. Differences in the relationship of building and contents loss costs from those previously found acceptable shall be reasonable.

Audit

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

Verified: YES

Professional Team Comments:

Discussed explanation of figures and tables shown in the submission.

Contents criteria within the model are unchanged from prior submission.

A-7 Additional Living Expenses (ALE)

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

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

C. The relationship between the modeled building and ALE loss costs shall be reasonable, based on the relationship between historical building and ALE losses. Differences in the relationship of building and ALE loss costs from those previously found acceptable shall be reasonable.

Audit

The modeler actuary 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.

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.

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

Professional Team Comments:

*****Initial Review Comments*****

Discussed ALE in detail relative to time to repair structure. Discussed methods used to calculate ALE loss costs.

Verification pending review of ALE data presented to the Professional Team.

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

Output Range changes since initial visit are attributable to the resolution of the ZIP Code issue and do not depend on the adjustments to ALE calculations.

Additional verification of Andrew ZIP Code test runs completed. Corrections appeared reasonable.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Use of Historical Data

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

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

Audit

Graphical comparisons of modeled and historical data and goodness-of-fit tests will be reviewed. Examples include hurricane frequencies, tracks, intensities, and physical damage. Forms S-10 and S-11 will be reviewed.

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

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

Professional Team Comments:

*****Initial Review Comments*****

Reviewed folders containing distributional fits. Considerable emphasis placed on track data and fitted time series models.

Verification pending review of Form S-11 to be revised and presented to the Professional Team.

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

Revisions to Form S-11 appear reasonable and are consistent with explanation of ZIP Code and ALE issues described on page 2.

S-2 Sensitivity Analysis for Model Output

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

Audit

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.

Form S-12 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Discussed the sensitivity of the standard deviation used in the sampling distribution for landfall frequency.

Discussed and reviewed results of one-variable-at-a-time studies performed on annual frequency, central pressure, radius of maximum winds, forward speed, and mean damage. Discussed multi-parameter studies involving the four variables of annual frequency, central pressure, radius of maximum winds, and mean damage. The sensitivity on loss costs were also examined.

Reviewed the results of a previous study reported on Form S-12 (previously Form F) and how AIR extended the study during the past year.

Reviewed graphs of standardized regression coefficients for loss cost by storm category for input variables of central pressure, forward speed, radius of maximum winds, and reduction factor.

S-3 Uncertainty Analysis for Model Output

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

Audit

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.

Form S-12 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Briefly reviewed a previous study conducted on Form S-12 (previously Form F) and how AIR extended the study during the past year.

S-4 County Level Aggregation

At the county level of aggregation, the contribution to the error in loss costs estimates induced by the sampling process shall be negligible based upon currently accepted scientific and statistical methods.

Audit

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

Verified: YES

Professional Team Comments:

Verified that the sampling contribution to loss costs errors was negligible.

S-5 Replication of Known Hurricane Losses

The model shall reasonably replicate incurred losses on a sufficient body of past hurricane events, 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 building-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

The following information for each insurer and hurricane will be reviewed:

1. 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,
2. The version of the model used to calculate modeled losses for each storm provided,
3. A general description of the data and its source,
4. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
5. The date of the exposures used for modeling and the date of the hurricane,
6. An explanation of differences in the actual and modeled storm parameters,
7. A listing of the departures, if any, in the wind field applied to a particular hurricane for the purpose of validation and the wind field used in the model under consideration,
8. The type of property used in each storm to address:
   a. Personal versus commercial
   b. Residential structures
   c. Mobile homes
   d. Condominiums
   e. Buildings only
   f. Contents only,
9. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.

The following documentation will be reviewed:

1. Publicly available documentation referenced in the submission,
2. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
3. An analysis that identifies and explains anomalies observed in the validation data,

4. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

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

Form S-6 will be reviewed.

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

Professional Team Comments:

*****Initial Review Comments*****

Discussed results shown in Figures 33 and 34 and reviewed the underlying data. Material revised while on-site.

Verification pending review of Form S-6 to be revised and presented to the Professional Team.

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

Discussed changes in exposures and changes in modeled output for Form S-6 and changes are consistent with the explanation of ZIP Code and ALE issues described on page 2.

S-6 Comparison of Estimated Hurricane Loss Costs

The difference, due to uncertainty, between historical and modeled annual average statewide loss costs shall be statistically reasonable.

Audit

Forms S-4, S-5, S-7, S-8, and S-9 will be reviewed.

Justify the following:

1. Meteorological parameters,
2. The effect of by-passing storms,
3. The effect of actual storms that have two landfalls impacting Florida,
4. The departures, if any, from the wind field, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration, and
5. Exposure assumptions.

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

Professional Team Comments:

*****Initial Review Comments*****

Discussed and reviewed the changes in the model that resulted in the change to the average annual statewide loss costs for simulated events.

Reviewed maps showing the contribution to the average annual loss for 1992 Hurricane Andrew modeled loss cost.

Reviewed loss ratios of simulated losses to 02 FHCF exposure for five randomly selected zip codes for Hurricane Andrew.

Verification pending review of Forms S-4, S-5, S-7, S-8, and S-9 to be revised and presented to the Professional Team.

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

Reviewed table of Hurricane Georges wind speed by Zip Code.

Reviewed revisions to Forms S-4, S-5, S-7, S-8, S-9. Reviewed specific contributions from several storms and determined that changes were consistent on the explanation of ZIP Code and ALE issues described on page 2.

Reviewed contribution of Hurricane Andrew losses by ZIP Code. Determined changes were consistent with the explanation of ZIP Code and ALE issues described on page 2. Reviewed changes in average loss and number of storms by range of loss on Form S-9. Reviewed two storm increase in total number of storms between previous and revised submissions. Differences were consistent with explanation of ZIP Code and ALE issues described on page 2.

Reviewed unsmoothed ZIP Code level maps for increased scrutiny of Form S-4. Reviewed changes in 2002 data on Form S-5 and determined changes are consistent with explanation of ZIP Code and ALE issues described on page 2.

S-7 Output Ranges

For a model previously found acceptable by the Commission, the differences in the updated output ranges shall be reasonable.

Audit

Forms S-1A, S-1B, S-2, and S-3 will be reviewed.

Justify the following:

1. Changes from the prior submission of greater than five percent in weighted average loss costs for any county.
2. Changes from the prior submission of five percent or less in weighted average loss costs for any county.

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

Professional Team Comments:

*****Initial Review Comments*****

Discussed the occurrences of 0.000 for the weighted average loss costs and verified the occurrences are due to the exposure weight file provided containing no exposure data for that policy form and construction within those counties.

Discussed the impact of the following model revisions on the statewide loss costs:

- ZIP Code database update
- Historical catalog update through 2002
- Revised approach to generating hurricane tracks
- Refined methodology for estimating the impact of land-use and land-cover
- Updates to the apartment and condominium vulnerability functions

Verification pending review of Forms S-1A, S-1B, S-2, and S-3 to be revised and presented to the Professional Team.

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

Form S-1A not applicable to subsequent review (S-1B sufficient).

Viewed various storm track maps.

Subsequent verification during the additional on-site review was consistent with the ZIP Code and ALE issues explained on page 2.

COMPUTER STANDARDS – Paul Fishwick, Leader

Reviewed the following changes in the model from last year:

Tropical Cyclone Model (2004):
- Updated catalog (annual landfall frequency, maximum wind speed radius calculations)
- Updated physical properties and building codes data
- Track Generation Algorithm and Blending Procedure

Analytical Engine:
- Bug fixes
- Multiple database support
- Database administration utility
- Geocoding enhancements
- Support for custom event sets (severe thunderstorm)

User Interface:
- Bug fixes
- Policy/Certificate, Book list filtering
- Spreadsheet-based import facilility
- New CLF/ALF export options
- Extended currency support

C-1 Documentation

A. The modeler shall maintain 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) relevant to the modeler's submission shall be consistently documented.

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

Audit

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.

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

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

Verified: YES

Professional Team Comments:

Reviewed AIR's primary document binder which contained fully documented sections for each computer standard and consistent documentation for all computer software relevant to the submission except for hurricane track joining.

The following material was revised on-site. For hurricane track joining, reviewed *AIR Atlantic Tropical Cyclone Model – Basin wide Track Generation – Joining NATL04 with HURLOG04* which contained documented sections for each computer standard.

Reviewed the following documentation:

- CLASIC/2 User's Guide
- CLASIC/2 Reference Manual
- CLASIC/2 – Version 5.7 Release Notes
- UNICEDE/px and UNICEDE/fx Preparer's Guide (Version 5.7)
- UNICEDE/px Optimization Instructions
- UNICDED/px Distribute

C-2 Requirements

The modeler shall maintain a complete set of requirements for the model, its computer implementation, and all appropriate model documentation.

Audit

The documentation of the requirements specifications will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the following documentation:

- AIR Tropical Cyclone Model
- Software Requirements Specification (SRS)

C-3 Model Architecture and Component Design

The modeler shall maintain information defining the model architecture and design of model components and sub-components.

Audit

The following will be reviewed:

1. Detailed control and data flow diagrams,
2. Interface specifications for all components in the model,
3. Documentation for schemas for all data files, along with field type definitions,
4. Each network diagram including components, sub-component diagrams, arcs, and labels.

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

Verified: YES

Professional Team Comments:

Reviewed the following documentation:

- CLASIC/2™ System Architecture
- Model Framework Documentation
- Model Flow Chart
- Component Custodian table and hierarchy
- Program flow charts for event generation and class diagrams for other portions of the model

C-4 Implementation

The software shall be traceable from the flow diagrams down to the code level.

Audit

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

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

The interfaces and the coupling assumptions will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed flow diagram documentation, indicating traceability from the diagrams to the code level.

Reviewed the following documentation:

- Model Classes Documentation
- Model Datafiles Documentation
- Model Flow Charts

C-5 Verification

A. General

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

B. Testing

Tests shall be performed for each software component, independent of all other components, to ensure that each component provides the correct response to inputs. The modeler shall use testing software to assist in documenting and analyzing all component test procedures and cases.

Audit

The code 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.

The testing of each component will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed verification procedures and examples of calculation cross checks, unit tests, and exception handling mechanisms.

Reviewed following documentation:

- Model Testing Summary – US Hurricane – 2004
- Unit Testing of Model 21 in CLASIC/2
- Software Design Specifications (SDS) – Screenshots
- Test Plans
- Test Suite for Enterprise Detail Screen
- Test Suite for Business Unit Detail Screen
- Test Suite for Book Detail Screen
- Test Suite for Company Detail Screen
- Test Suite for Policy Detail Screen
- Sample SilkTest script for GUI Testing

C-6 Model Maintenance and Revision

A. The modeler shall have developed and implemented a clearly written policy for model revision with respect to methodologies and data.

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

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

Verified: YES

Professional Team Comments:

Reviewed the following documentation:

- Microsoft Sourcesafe online documentation
- Policy Statement
- AIR Data Control Process
- AIR Software Documentation Process
- AIR Task application to maintain code, data, and documentation

Current Versions:

- Hurricane Model: Atlantic Tropical Cyclone Model 5.0.211
- Comprehensive Software: CLASIC/2 5.5

C-7 Security*

*(*New Standard)*

The modeler shall have implemented security procedures for access to code, data, and documentation in accordance with standard industry practices.

Audit

Provide a written policy for all procedures and methods used to ensure the security of code, data, and documentation. Specify all security procedures.

Verified: YES

Professional Team Comments:

Reviewed AIR code, data, and security policy documentation.