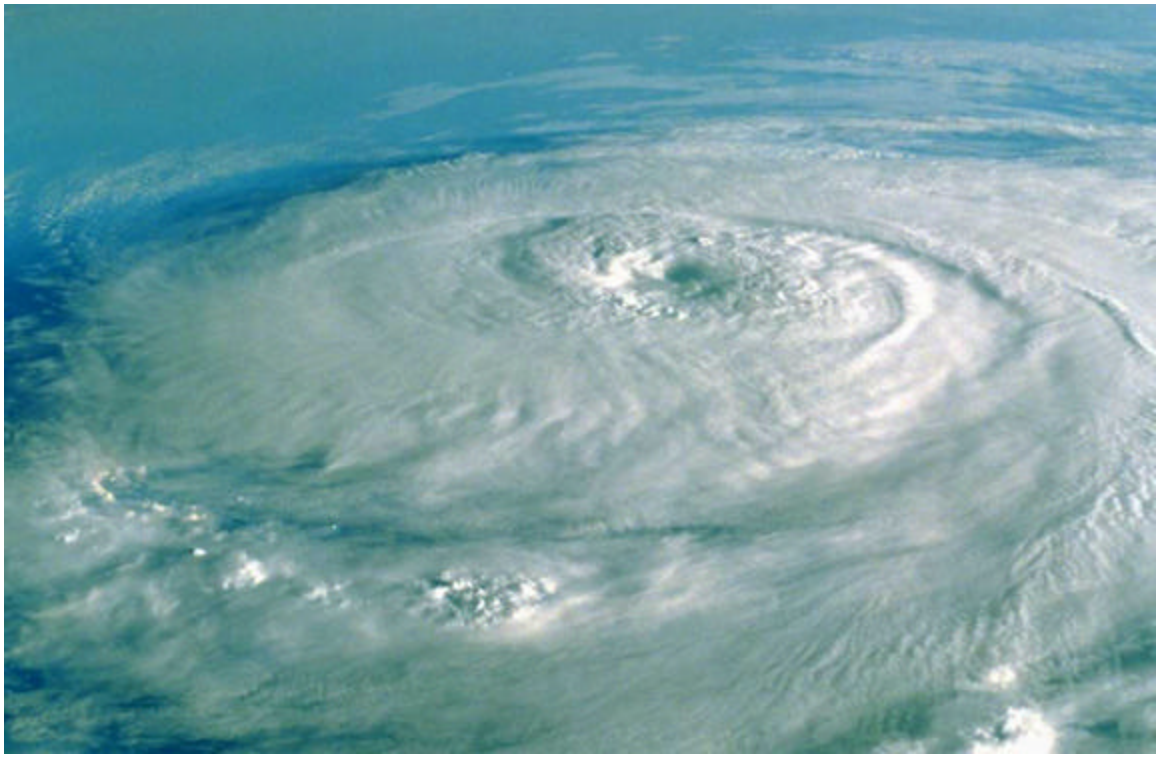
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Audit Report
2001 Standards

Applied Insurance Research, Inc.

On-Site Review
May 6 – 8, 2002

On May 6 – 8, 2002, the Professional Team visited on-site at Applied Insurance Research, Inc. (AIR) in Boston, Massachusetts. The following people participated in the review.

AIR

Robert Ballantyne, Statistician
Boris Davidson, Technical Manager, Chief Software Architect
Paul Gauss, Technical Writer
Jayanta Guin, Ph.D., Vice President, Research and 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
Miriam Perkins, ACAS, MAAA, Actuarial Analyst
John Rowe, Senior Research Engineer
Vinita Saxena, Ph.D., Senior Research Engineer
Hector Suazo, Manager, Technical Production Services

Professional Team

Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Ron Iman, Ph.D., Statistician
Paul Fishwick, Ph.D., Computer Scientist
Tom Schroeder, Ph.D., Meteorologist
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 on the changes to the model from the previous year which include:

- Refitted annual frequency distribution,
- Update of population weighted zip code centroids,
- Update of commercial building damage functions, and
- Update of Renter/Condo Damage Functions resulting from building damage function revision (above).

AIR provided responses to the issues raised in the March 29th electronic correspondence and discussed during the April 8, 2002 conference call. Further supporting materials were presented upon request.

Reviewed revised pages from submission to be resubmitted prior to the May 29-31 Commission meeting.

5.1 General Standards – *Mark Johnson, Leader*

5.1.1 Scope of the Computer Model and Its Implementation

The computer model shall project loss costs for personal lines residential property from hurricane events, excluding flood and storm surge, except as flood and storm surge apply to Additional Living Expense (ALE). References to the model throughout the Standards shall include its implementation.

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified no change in the model with regards to the exclusion of flood and storm surge. Reviewed actual company loss data and exposure data assumptions.

5.1.2 Qualifications of Modeler Personnel and Independent Experts

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.

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 or Member of the American Academy of Actuaries), meteorology (advanced degree), and computer science/engineering (advanced degree). These individuals shall abide by the standards of professional conduct adopted by their profession.

Reference: Module 2, Section I, #2-#3 (pages 127 – 138)
Reference: Module 2, Section I, #5 (pages 140 – 142)

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Reviewed vita of new AIR personnel:

- Miriam E. Perkins, BS Mathematics and Economics, University of New Hampshire

- Mark Wolfskehl, Ph.D., Computer Science, Stevens Institute of Technology

5.1.3 Modelers Policy of Model Revision

The modeler shall have developed and implemented a clearly written policy for model revision with respect to methodologies and data. The modeler shall clearly identify the model version under review. Any revision to any portion of the model that results in a change in any Florida residential hurricane loss cost must be accompanied by a new model version number.

Reference: Module 1,Section I, A.1 (page 63)
Reference: Module 1, Section I, A.9 (pages 92 – 93)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed AIR's documentation for model revision and release. Verified that changes from previous year's submission are embodied in the computer model producing output ranges. Results in Form B, Form F, and AIR's internal sensitivity analyses generated directly through their model.

5.1.4 Independence of Model Components

The meteorology, vulnerability, and actuarial components of the model shall each be demonstrated to 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 demonstrated to be reasonable.

Reference: Module 1, Section II, B.11 (page 112)
Reference: Module I, Section II, B.13-15 (pages 115 – 117)
Reference: Standard 5.5.3 (page 52)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

In the course of the review, verified the independence of the meteorology, vulnerability, and actuarial components of the model and found them to be theoretically sound and unbiased. Changes from previous year did not introduce dependencies.

5.1.5 Risk Location

Zip codes used in the model shall be updated at least every 24 months using information originating from the United States Postal Service. The date of the updated information shall be disclosed.

Zip code centroids, when used in the model, shall be based upon population data and shall be visually demonstrated to be reasonable.

Zip code information purchased by the modeler shall be verified by the modeler for accuracy and appropriateness.

Reference: Module 3, Section VI, #1 (page 181)
Reference: Module 3, Form A (page 184)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed maps of population weighted Zip Code centroids highlighting the changes generated from updating the Zip code database. Discussed the procedure AIR uses for verifying the accuracy of the Zip Code database and how changes and discrepancies in the data are handled.

5.1.6 Identification of Units of Measure of the Model

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

Reference: Module 1, Section I, C.2 (page 98)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

All visual presentations shown were clearly labeled in the appropriate units of measure, including proprietary versions shown to Professional Team.

5.1.7 Visual Presentation of Data

Visualizations shall be accompanied by legends and labels for all elements. Individual elements shall be clearly distinguishable, whether presented in original or copy form.

a. For data indexed by latitude and longitude, by county or by zip code, a color contour map and a continuous tone map with superimposed county and zip code boundaries shall be produced.

b. Florida Map Colors: Maps will use two colors, blue and red, along with shades of blue and red, with dark blue and dark red designating the lowest and highest quantities, respectively. The color legend and associated map shall be comprised of an appropriate number of intervals to provide readability.

Reference: Module 3, Section V, #3 (Attachment H)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified that all visualizations to be presented to the Commission have the required characteristics. Reviewed numerous color-coded maps.

5.2 Meteorological Standards – *Tom Schroeder, Leader*

5.2.1 Units of Measure for Model Output

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

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Verified materials presented throughout the review conformed to standard.

5.2.2 Damage Function Wind Inputs

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 which are supported by literature and/or documented measurements available to the Commission.

Reference: Module 3, Section II, #2 (page 157)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed conversion factors and verified no change from previous year.

5.2.3 Official Hurricane Set or Suitable Approved Alternatives

Modelers shall include in their base storm set all hurricanes, including by-passing hurricanes, which produce hurricane force winds in Florida. The storm set, derived from the Tropical Prediction Center/National Hurricane Center (TPC/NHC) document *Tropical Cyclones of the North Atlantic Ocean, 1871-1998,* updated through the 2000 hurricane season and/or the HURDAT (HURricane DATa) data set, is found in the *Report of Activities as of November 1, 2001* under Section VII, Compliance With Standards and Related Information, #4. All proposed alternatives to the characteristics of specific storms in the storm set shall be subject to the approval of the Commission.
Reference: Module 1, Section II, B.7-8 (page 68)
Reference: Module 3, Section I (pages 143 – 156)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Examined updated storm set including revised catalogue of storms.

5.2.4 Hurricane Characteristics

Methods for depicting all modeled hurricane characteristics (e.g., wind speed, minimum central pressure, radius of maximum winds, strike probabilities, and tracks) shall be based on information documented by scientific literature or modeler information accepted by the Commission.

Reference: Module 1, Section II, B.1-8 (pages 104 – 110)
Reference: Module 3, Section I (pages 143 – 156)
Reference: Standard 5.6.2 (page 57)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

AIR has revised the method by which they define historical tracks. Examined illustrations of new versus old tracks and their influence on historical versus modeled losses.

5.2.5 Landfall Intensity

Models shall use maximum one-minute sustained 10-meter wind speed when defining hurricane landfall intensity. This applies both to the base storm set adopted in 5.2.3 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:
A scale from 1 to 5 that measures hurricane intensity.

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

Reference: Module 3, Section I, #1-3 (pages 143 – 144)
Reference: Module 3, Form B
Reference: Standards 5.6.2 and 5.6.3 (pages 57 – 60)

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Reviewed tables of landfall wind speed observations and modeled values.

Form B results are produced using a special catalogue of storms. The same code used to produce loss costs is used to produce the results of Form B. Reviewed detailed maps of maximum wind speeds for locations within zip codes.

5.2.6 Hurricane Probabilities

Modeled hurricane probabilities shall reasonably match the historical record through 2000 for category 1 to 5 hurricanes, shall be consistent with those observed for each geographical area of Florida, and shall be displayed in vertical bar graphs. "Consistent" means: (1) spatial distributions of modeled hurricane probabilities shall accurately depict vulnerable coastlines in Florida; and (2) probabilities are compared with observed hurricane frequency using methods documented in accepted scientific literature or proposed by the modeler and accepted by the Commission.

Reference: Module 1, Section I, B.2 (page 94)
Reference: Module 1,Section II, B.7 (pages 107 – 109)
Reference: Module 3, Section I (pages 143 – 156)
Reference: Standards 5.6.2 and 5.6.3 (pages 57 – 60)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed graphical representations of spatial distributions for Florida coastlines and related goodness of fit tests. In particular, discussed at length page 15 and pages 152-153 of the submission.

5.2.7 Hurricane Probability Distributions

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 as documented in accepted scientific literature available to the Commission.

Reference: Module 1, Section II, B.1 (page 104)
Reference: Module 1, Section II, B.7-8 (pages 107 – 110)
Reference: Module 3, Section 1, #2 (page 144)
Reference: Module 3, Section 1, #8 (page 147)
Reference: Standards 5.6.2 and 5.6.3 (pages 57 – 60)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified that AIR's modeled probability distributions are consistent with observed historical hurricanes and are consistent with observed Atlantic extremes as documented in accepted scientific literature. Discussed at length the dependence of central pressure and radius of maximum winds.

5.2.8 Land Friction

Land friction shall be used in the model to reduce wind speeds over land, shall be based on scientific methods, and shall provide realistic wind speed transitions between adjacent zip codes, counties, and territories. The magnitude of friction coefficients shall be consistent with accepted scientific literature, consistent with geographic surface roughness, and shall be implemented with appropriate geographic information system data.

Reference: Module 1, Section II, B.4-5 (pages 105 – 106)
Reference: Module 3, Section I (pages 143 – 156)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified no change in submission from last year. Reviewed figures presented in the submission on pages 18-19.

5.2.9 Hurricane Overland Weakening Rate

The hurricane overland weakening rate used by the model shall be bounded by the observed extremes in historical records for Florida. The mean wind speed shall be within twenty percent (20%) of the Kaplan/DeMaria decay value or an alternative acceptable to the Commission.

Reference: Module 1, Section II, B.3 (page 104)
Reference: Module 3, Section I (pages 143 – 156)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified there was no change from last year and AIR is within 20% of the Kaplan/DeMaria filling rate.

5.3 Vulnerability Standards – *Fred Stolaski, Leader*

General discussion held on changes to the condo owners, renters Commercial Residential damage function and the impact these changes have on the loss costs in the submission. Damage function comparisons on condo owners frame and masonry – apartment commercial superior non-combustible – residential wood frame – commercial wood frame – apartment wood frame. Clarified definitions.

5.3.1 Derivation of Vulnerability Functions

The method of derivation of the vulnerability functions shall be described and demonstrated to be theoretically sound.

Development of the vulnerability functions is to be based on one or more of the following: (1) historical data; (2) tests; (3) structural calculations; (4) expert opinion. Any development of the vulnerability functions based on structural calculations and/or expert opinion shall be supported by tests and historical data to the extent such data are available.

Reference: Module 1, Section I, A.8 (pages 89 – 92)
Reference: Module 3, Section III (pages 158 – 160)
Reference: Module 3, Section IV, #3-6 (pages 162 – 164)
Reference: Standard 5.6.2 (page 57)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified no change to damage functions for personal residential. Reviewed changes in commercial building damage functions and impact on coverage B, C, and D.

5.3.2 Required Vulnerability Functions

Vulnerability functions shall separately compute damages for building structures, mobile homes, appurtenant structures, contents, and additional living expense.

Reference: Module 3, Section III (pages 158 – 160)
Reference: Module 3, Section IV, #3 (page 162)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed details on the vulnerability functions and verified separate functions exist for building structures, mobile homes, appurtenant structures, contents and ALE.

5.3.3 Wind Speeds Causing Damage

Damage associated with a declared hurricane event shall include damage incurred for wind speeds above and below the hurricane threshold of 74 mph. The minimum wind speed that generates damage shall be specified.

Reference: Module 3, Section III (pages 158 – 160)

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Verified no change in submission from last year. The minimum wind speed that causes damage is 40 mph.

5.3.4 Construction Characteristics

In the derivation and application of vulnerability functions, assumptions concerning construction type and construction characteristics shall be demonstrated to be reasonable and appropriate.

Reference: Module 1, Section I, A.7 (pages 86 – 89)
Reference: Module 3, Section III (pages 158 – 160)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed AIR's residential construction types used in the vulnerability functions and details contained in Hurricane Individual Risk Methodology binder. Verified no change in construction characteristics other than a change to the descriptions to correlate with the user's software manual.

5.3.5 Modification Factors

Modification factors to the vulnerability functions or structural characteristics and their corresponding effects shall be disclosed and shall be clearly defined and their theoretical soundness demonstrated.

Reference: Module 3, Section III, #3 (page 158)
Reference: Module 3, Section III, #6 (page 160)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed details on the vulnerability modification factors and verified they all fall within the +25% to –25% range.

5.3.6 Additional Living Expenses

In the estimation of Additional Living Expenses (ALE), the model shall consider hurricane damage including storm surge damage to the infrastructure.

The Additional Living Expense vulnerability function shall consider the time it will take to repair/reconstruct the home.

Reference: Module 3, Section IV, #5-6 (pages 163 – 164)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed details on development of ALE loss functions and verified no change from last year other than change resulting from revised commercial building damage functions (found to be reasonable).

5.3.7 Mitigation Measures

Modeling of mitigation measures to improve a building's wind resistance and the corresponding effects on vulnerability shall be disclosed and demonstrated to be theoretically sound.

Proprietary: Yes
Verified: Yes

Professional Team Comments:

AIR gave presentation of wide variety of features which included construction characteristics and mitigation factors. Reviewed calculations for sample buildings with these features and ranges of change in loss costs due to each of the factors. Discussed field observations made by engineering teams to various storm sites. Studied references which supported engineering judgment.

Sample References:

- Building Wind Damage Prediction and Mitigation Using Damage Bands by Unanwa and others
- Roof Sheathing Uplift Resistance for Hurricanes by Sutt, et.al
- Design 1, Shutters for Wood-Frame Building by APA
- FWUA ClassPlan Survey – Joint Operation by AIR, EQE, and RMS to determine factors for mitigation items.

5.4 Actuarial Standards – *Marty Simons, Leader*

5.4.1 Underwriting Assumptions

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. The methods used shall be documented in writing.

For damage estimates derived from historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, and (3) relevant underwriting practices underlying those losses shall be identified and demonstrated to be reasonable and appropriate.

Reference: Module 1, Section I, B.4 (pages 94 – 97)
Reference: Module 1, Section II, A.3-5 (pages 100 – 103)
Reference: Module 3, Section IV (pages 161 – 169)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Discussed use of actual insurance claims data, detection of errors and method for correcting errors found. Reviewed examples of new insurance claims data received in the past year.

5.4.2 Actuarial Modifications

All modification factors to the actuarial functions or characteristics including but not limited to building code, quality, age, occupancy, stories, or condition of structure and their corresponding affects shall be disclosed and shall be clearly defined and their actuarial soundness demonstrated**.** The disclosure of modification shall include a description of the impact upon loss costs of the modification in accordance with the following:

A: < -50%
B: -50% to -25%
C: -25% to 0
D: 0 to 25%
E: 25% to 50%
F: > 50%

Reference: Module 1, Section I, A.6 (page 85)
Reference: Module 1, Section I, A.10 (page 93)
Reference: Module 1, Section I, C.1.c (pages 97 – 98)
Reference: Module 3, Section III, #3 (page 158)

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Verified no change from previous years. AIR does not use modification factors to the actuarial functions. Reviewed vulnerability mitigation criteria and ranges in conjunction with this standard.

5.4.3 Loss Cost Projections

Loss cost projections produced by hurricane loss projection models shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin. Hurricane loss projection models shall not make a prospective provision for economic inflation.

Reference: Module 1, Section I, B.4 (pages 94 – 96)
Reference: Module 1, Section I, C.1.a (page 97)
Reference: Module 3, Section III, #2 (page 158)
Reference: Module 3, Section V (pages 170 – 180)
Reference: Module 3, Section VII (pages 182 – 190)

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Verified no change in submission. AIR uses insurance company daims data. Verified “loss adjustment expense” switch is turned off for Florida loss costs.

5.4.4 Insurer Inputs

The modeler shall disclose any assumptions, fixed and variable, that relate to insurer input. Such assumptions shall be demonstrated to be actuarially sound. Assumptions that can vary by specific insurer shall be disclosed in a model output report. Fixed assumptions, that do not vary, need to be disclosed to the Commission.

Reference: Module 1, Section I, A.10 (page 93)
Reference: Module 1, Section I, B.4 (pages 94 – 96)
Reference: Module 1, Section II, A.3-4 (pages 100 – 102)
Reference: Module 3, Section IV (pages 161 – 169)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified no change to the model from last year. AIR submitted their input form in the submission. Discussed AIR's method of remapping client data to the UNICEDE®/px format if necessary.

5.4.5 Demand Surge

Loss cost projections shall not explicitly include demand surge. Any adjustment to the model or historical data to remove implicit demand surge, shall be disclosed and shall be demonstrated to be reasonable.

Reference: Module 1, Section I, C.1.a (page 97)
Reference: Module 3, Section III, #2 (page 158)
Reference: Module 3, Section VII (pages 182 – 190)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified that demand surge was not used in preparation of loss cost projections. Reviewed actual claims data showing demand surge was excluded. Verified "demand surge" switch was turned off for Florida loss costs.

5.4.6 Loss Costs - Meaning of "Damage"

In calculating loss costs, damage shall be expressed as insurable losses.

Reference: Module 1,Section II, A.5 (page 103)

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Verified model loss costs are based on insurance losses.

5.4.7 Logical Relation to Risk

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.

1. Loss costs produced by the model shall be positive and non-zero for all zip codes.

2. Modelers shall produce color-coded maps for the purpose of comparing loss costs by five-digit zip code within each county and on a statewide basis.

3. Loss costs cannot increase as friction or roughness increase, all other factors held constant.
4. Loss costs cannot increase as the quality of construction type, materials and workmanship increases, all other factors held constant.

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

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

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

The above tests are intended to apply in general. There may be certain anomalies that are insignificant or are explainable by special circumstances. This standard applies separately to each coverage.

Reference: Module 1, Section I, C.1.b (page 97)
Reference: Module 3, Section V, #2 (pages 170 – 173)
Reference: Module 3, Section V, #5 (page 174)
Reference: Module 3, Section VII (pages 182 – 190)

Proprietary: **Some Proprietary**
Verified: **Yes**

Professional Team Comments:

Reviewed color-coded maps and graphical representations of the relationship between modeled and actual losses.

5.4.8 Deductibles and Policy Limits

The model shall provide a mathematical representation of the distribution of losses to reflect the effects of deductibles and policy limits, and the modeler shall demonstrate its actuarial soundness.

Reference: Module 1, Section I, B.3 (pages 94)
Reference: Module 3, Section IV, #1-2 (pages 161 – 162)
Reference: Standard 5.6.2 (page 57)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed graphical representations of the distributions and verified no change in the submission from last year.

5.4.9 Contents

The model shall provide a separate mathematical representation of contents loss costs, and the modeler shall demonstrate its actuarial soundness.

Reference: Module 3, Section IV, #5 (page 163)
Reference: Module 3, Section IV, #7 (page 164)
Reference: Standard 5.6.2 (page 57)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Verified residential contents loss did not change due to the modifications made to the condo owners contents function. Condo renters loss costs variation in accord with “commercial” building damage function revisions.

5.4.10 Additional Living Expenses (ALE)

The model shall provide a separate mathematical representation of Additional Living Expense (ALE) loss costs, and the modeler shall demonstrate its actuarial soundness.

Reference: Module 3, Section IV, #6 (page 164)
Reference: Standard 5.6.2 (page 57)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified residential ALE loss did not change due to the changes made to the condo owners ALE function. Condo renters loss costs variation in accord with "commercial" building damage function revisions.

5.4.11 Building Codes

Information upon which building code quality and enforcement is assessed, if incorporated in the model, shall be objective and reasonably accurate and reliable.

Reference: Module 1, Section 1, C.1.b (page 97)
Reference: Module 3, Section III, #3 (page 158)
Reference: Standard 5.6.2 (page 57)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Verified that the model does not include adjustments for building code enforcement.

5.4.12 Hazard Mitigation

Data or information upon which differences in loss costs due to fixtures, design features, or construction techniques designed for hazard mitigation are derived, if incorporated in the model, shall be objective and actuarially reasonable.

Reference: Module 1, Section I, A.6 (page 85)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed mitigation modifications as discussed in standard 5.3.7.

5.4.13 Replication of Known Hurricane Losses

The model shall be shown to 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 mobile homes to the extent data are available. Personal residential experience may be used to replicate building-only and contents-only losses. The modeler shall demonstrate that the replications were produced on an objective body of loss data by county or an appropriate level of geographic detail.

Reference: Module 3, Section IV, #9 (pages 166 – 168)
Reference: Module 3, Section V, #2 (pages 170 – 173)
Reference: Standard 5.6.3 (page 60)

Proprietary: **No**
Verified: **Yes**

Professional Team Comments:

Reviewed details of the comparison charts data on substantial amount of actual versus modeled losses. Reviewed and discussed differences between actual and modeled losses.

5.4.14 Comparison of Estimated Hurricane Loss Costs

The model shall provide the annual average zero deductible statewide loss costs produced using the list of hurricanes in standard 5.2.3 historical hurricanes in Florida based on the 1998 Florida Hurricane Catastrophe Fund's (FHCF) aggregate personal residential exposure data, as of November 1, 1999. These will be compared to the statewide loss costs produced by the model on an average industry basis. The difference, due to uncertainty, between historical and modeled annual average statewide loss costs shall be demonstrated to be statistically reasonable.

Reference: Module 3, Section I, #7 (pages 145 – 146)

Reference: Module 3, Section I, #10 (pages 148 – 150)
Reference: Module 3, Section V, #2 (pages 170 – 173)
Reference: Module 3, Section V, #4 (Output Ranges pages 193 – 227)
Reference: Standard 5.6.3 (page 60)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed and verified t-tests showing the difference between historical and modeled loss to be statistically insignificant.

5.4.15 Output Ranges

Any model previously found acceptable by the Commission shall provide an explanation suitable to the Commission concerning the updated output ranges. Differences between the prior year submission and the current submission shall be explained in the submission including, but not limited to:

1. Differences from prior submission of greater than ten percent in maximum or minimum loss costs for any county shall be specifically listed and explained.
2. Differences from prior submission in the relativities between loss costs for building and the corresponding loss costs for contents shall be explained.
3. Differences from prior submission in the relativities among corresponding deductibles shall be explained.

Reference: Module 3, Section V, #4-5 (page 174, Output Ranges pages 193 – 227)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed changes from previous year submission and verified they were only attributable to the revised storm set, revisions to the commercial damage functions (where applicable), and the updated Zip code database.

5.4.16 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 demonstrated to be negligible.

Reference: Module 1,Section II, C.2 (pages 119 – 120)
Reference: Standard 5.6.3 (page 60)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

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

5.4.17 Total Estimated Losses

The modeler shall demonstrate through the information submitted in Form B and Form D (Module 3, Section VII) that the model produces reasonable relationships among the total estimated losses produced by the model for building, appurtenant structures, contents, and additional living expense.

Reference: Module 3, Section VII Form B & Form D

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed details provided showing the simulated losses at each coverage level A-D. Reviewed information provided on Form B and Form D and the relationship by coverage modeled from Form B and Form D with actual company data provided.

5.5 Computer Standards – *Paul Fishwick, Leader*

5.5.1 Primary Document Binder

A primary document binder, in either electronic or physical form, shall be created, and shall contain fully documented sections for each subsequent Computer Standard. Development of each section shall be indicative of accepted software engineering practices. All computer software (i.e., user interface, scientific,

engineering, actuarial) relevant to the modeler's submission must be consistently documented.

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module 1, Section II (pages 99 – 123)

Proprietary: Yes
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.

5.5.2 Requirements

The modeler shall document all requirements specifications of the software, such as interface, human factors, functionality, documentation, data, human and material resources, security, and quality assurance.

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module 1, Section II (pages 99 – 123)
Reference: Module 3, Section VI, #2 (page 181)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed the following documentation:

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

5.5.3 Software Architecture and Component Design

The modeler shall document detailed control and data flow diagrams, interface specifications, and a schema for all data files along with field type definitions. Each network diagram shall contain components (including referenced sub-component diagrams), arcs, and labels. A *model component custodian* (that individual who can explain the functional behavior of the component and respond to questions concerning changes in code, documentation, or data for that

component) shall be identified and documented. For each component in the system decomposition, the modeler shall list the installation date under configuration control, the current version number, and the date of the most recent change(s).

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module 1, Section II (pages 99 – 123)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed the following documentation:

- CLASIC/2™ System Architecture
- Model Framework Documentation
- Model Flow Chart
- Component Custodian table and hierarchy

5.5.4 Implementation

The software shall be traceable from the flow diagrams and their components down to the code level. All documentation, including document binder identification, shall be indicated in the relevant component. The highest design level components shall incrementally be translated into a larger number of components until the code level is reached.

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module 1, Section II (pages 99 – 123)

Proprietary: Yes
Verified: Yes

Professional Team Comments:

Reviewed the following documentation:

- Model Classes Documentation
- Model Datafiles Documentation

5.5.5 Software Verification

The modeler shall employ and document procedures employed, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. The code shall contain 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.

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module 1, Section II (pages 99 – 123)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

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

5.5.6 Testing

Tests shall be documented for each software component, independent of all other components, to ensure that each component provides the correct response to inputs. All components when interfaced shall function correctly.

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module 1, Section II (pages 99 – 123)
Reference: Standards 5.6.4 and 5.6.5 (pages 60 – 62)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed the following documentation:

- Software Design Specifications (SDS) – Screenshots
- CLASIC/2 Testware Library
- GUI – Testing Guidelines
- Unit Test sample documentation

5.5.7 Software Maintenance and Revision

The modeler shall specify all policies and procedures used to maintain code, data, and documentation. The modeler shall use tracking software to track all errors, as well as modifications to code, data, and documentation.

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module 1, Section II (pages 99 – 123)

Proprietary: **Yes**
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 V4.1.0
- Comprehensive Software: CLASIC/2 V3.0

5.5.8 User Documentation

The modeler shall have complete user documentation including all recent updates.

Reference: Module 1, Section I (pages 63 – 98)
Reference: Module I, Section II (pages 99 – 123)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed the following documentation:
- CLASIC/2 User's Guide
- CLASIC/2 Reference Manual
- CLASIC/2 – Version 2.2.0 Release Notes
- UNICEDE/px and UNICEDE/fx Preparer's Guides
- UNICDED/px Optimization Instructions
- UNICDED/px Distribute

5.6 STATISTICAL STANDARDS – *Mark Johnson, Leader*

5.6.1 Use of Historical Data

The use of historical data in developing the model shall be demonstrated to be reasonable using rigorous methods published in the scientific literature.

Reference: Module 1, Section II, B.12 (pages 112 – 114)
Reference: Module 3, Section I, #7 (pages 145 – 146)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed results of statistical tests on various distribution fits.

5.6.2 Comparison of Historical and Modeled Results

The modeler shall demonstrate the agreement between historical and modeled results for hurricane frequencies, tracks, intensities, and physical damage using accepted scientific and statistical methods.

Reference: Module 1, Section II, A.1 (pages 99 – 100)
Reference: Module I, Section II, B.7 (pages 107 – 109)
Reference: Module 1, Section II, C.1 (pages 118 – 119)
Reference: Module 1, Section II, C.3 (pages 121 – 122)
Reference: Module 1, Section II C.5-6 (pages 122 – 123)
Reference: Module 3, Section III, #4-5 (page 159)
Reference: Module 3, Section IV, #3-6 (pages 162 – 164)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed several statistical tests provided on comparisons of historical versus modeled results based on central pressure, Rmax, and forward speed, for example. Examined historical versus modeled results for numerous storms and companies with particular attention to changes from last year's submission.

5.6.3 Uncertainty Characterization

The modeler shall provide an assessment of uncertainty using confidence intervals or other accepted scientific characterizations of uncertainty.

Reference: Module 1, Section II, B.9 (pages 110 – 111)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed probability distributions on the fits to historical data and the standard errors computed for parameter estimates. Reviewed histograms on modeled losses. Examined distributions of historical and modeled results for 5.4.14 (alternatives to t-test).

5.6.4 Sensitivity Analysis for Model Output

The modeler shall demonstrate that the model has been assessed with respect to sensitivity of temporal and spatial outputs to the simultaneous variation of input parameters using accepted scientific and statistical methods. Statistical techniques used to perform sensitivity analysis shall be explicitly stated and the results of the analysis shall be presented in graphical format.

Reference: Module 1, Section I, A.5 (pages 73 – 85)
Reference: Module 1, Section II, B.13-15 (pages 115 – 117)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

Reviewed details on the sensitivity studies conducted on the Form F data as well as AIR's internal sensitivity study. AIR and Professional Team analyses matched. AIR performed further analyses beyond the basic Form F.

5.6.5 Uncertainty Analysis for Model Output

The modeler shall demonstrate that the temporal and spatial outputs of the model have been subjected to an uncertainty analysis using accepted scientific and statistical methods. The analysis shall identify and quantify the extent that input variables impact the uncertainty in model output as the input variables are simultaneously varied. Statistical techniques used to perform uncertainty analysis shall be explicitly stated and results of the analysis shall be presented in graphical format.

Reference: Module 1, Section I, A.5 (pages 73 – 85)
Reference: Module 1, Section II, B.9 (pages 110 – 111)
Reference: Module 1, Section II, B.13-15 (pages 115 – 117)

Proprietary: **Yes**
Verified: **Yes**

Professional Team Comments:

AIR presented their uncertainty analyses of Form F, which were based on the examples given in the Professional Team demonstration analysis. Verified AIR analysis agreed with the results prepared by the Professional Team. AIR further expanded on the demonstration analysis by computing and plotting the total loss across the samples at each grid point on the maximum wind speeds generated from Form F. Assessed conclusions from both Form F and AIR studies and discussed possible future refinements.