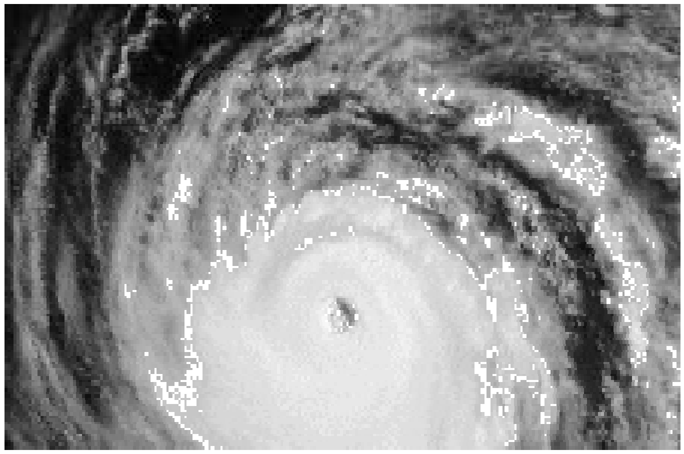
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Audit Report

Applied Insurance Research, Inc. (AIR)

On-Site Review
April 26, 2001

On April 26, 2001, the Professional Team visited on-site at Applied Insurance Research, Inc.(AIR) in Boston, Massachusetts. The following people participated in the review:

AIR

David Lalonde, FCAS, FCIA, MAAA, Senior Vice President
Vivek Pawale, Ph.D., Research Mathematician
S. Ming Lee, Senior Vice President, Operations
Jianming Yin, Principal Engineer
Hector Suazo, Manager, Technical Production Services
John L. Keller, Ph.D., CCM, Senior Research Scientist, Meteorology
Jayanta Guin, Ph.D., Assistant Vice President, Research and Modeling
Greta M. Ljung, Ph.D., Senior Research Statistician
Shangyao Nong, Ph.D., Research Scientist, Meteorology
John Rowe, Senior Research Engineer
Vivek Basrur, Senior Vice President, Software Research and Development
Boris Davidson, Technical Manager, Chief Software Architect
Eric Aftandilian, Manager, Software Quality Assurance
Jorge Porto, Manager, Software Development Group
Paul Gauss, Software Documentation Editor
Vinita Saxena, Ph.D., Research Engineer

Professional Team

Mark Johnson, Ph.D., Statistician, Team Leader
John Pepper, P.E., Structural Engineer
Peter Ray, Ph.D., Meteorologist
Marty Simons, ACAS, Actuary
Paul Fishwick, Ph.D., Computer Scientist
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process.

FORM C

AIR had indicated they could not complete Form C initially because the Commission only provides a peak wind speed where their model needs the duration or a complete time profile of wind speeds. AIR presented a completed Form C (attached) using Hurricane Andrew with the given parameters under two assumptions

(1) doubled the forward wind speed of the storm
(2) half the forward wind speed of the storm.

Florida Commission on Hurricane Loss Projection Methodology

2000 Standards

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

Pro Team Comments:

During the on-site review the Professional Team was shown details on exclusion of flood and storm surge. Storm surge off is the default on any run in the model.

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). Where applicable, these individuals shall abide by the standards of professional conduct adopted by their profession.

Reference: Module 2, Section I, #2-#3 (pages 120-127)
Reference: Module 2, Section I, #5 (pages 131-132)

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

Pro Team Comments:

Reviewed the following resumes:

Eric Aftandilian, Software Quality Assurance
Greta M. Ljung, Ph.D., Senior Research Statistician
Vivek Basrur, Senior Vice President, Software Development Group
Jayanta Guin, Ph.D., Assistant Vice President
Boris Davidson, Software Engineer
Jorge M. Porto, Software Engineer
Vinita Saxena, Ph.D., Wind Engineer

Revisited Attachment D, a peer review by J. E. Minor, Ph.D., P.E. Texas Tech as AIR does not have a licensed Structural Engineer on staff.

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.

Reference: Module 1,Section I, A.1 (page 59)
Reference: Module 1, Section I, A.9 (pages 84-85)

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

Pro Team Comments:

AIR demonstrated their written policy has been in operation since the previous review.

Software revision from using Fortran to C++, different convolution algorithm in C++, code change in coverage D.

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 105)
Reference: Module I, Section II, B.13-15 (pages 107-110)
Reference: 5.5.3 (page 48)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Individual components determined theoretically sound in sections 2-4. No bias issues detected in course of review.

5.1.5 Geographic Location

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

Zip code centroids shall be derived by using either population or geography and shall be visually demonstrated to be reasonable.

If the model uses geographic location at a more refined level than zip code (e.g., latitude/longitude), such uses shall be visually demonstrated to be reasonable.

Reference: Module 3, Section VI, #1-#2 (page 167)
Reference: Module 3, Form A (page 170)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed maps of population centroids indicated within zip code boundaries.

At this time the Professional Team reviewed the error disclosed in last year's submission and the impact it had on loss costs. AIR confirmed this was a one-time change going from zip code based on population to geographic based due to an error in loading data from separate files. The Zip Code centroids procurement and implementation process was reviewed. AIR purchases centroids from a vendor and inputs the data into AIRs working files and then completes a table lookup on the zip code numbers and centroids. The area has typically been provided by the vendor. In last year's process the vendor did not provide the area and AIR had to pull it from another file. In doing so, they pulled the centroids from that file as well as the area. Previously AIR has always used population based zip codes. The net result or difference was very small. The difference in loss costs was larger in several zip codes but less than 1% for the whole state of Florida. Going from geographic back to population weighted centroids produced a decrease in the loss costs of less than 1%.

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 (pages 90-91)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Verified in course of review of other standards.

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.

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Professional Team reviewed visualizations.

5.1.8 Disclosure of User Supplied Input

A modeler shall clearly disclose, in a model output report, the specific type of input which is required of insurers in order to use the model in a residential property insurance rate filing. Such input includes, but is not limited to, optional features of the model, type of data to be supplied by the insurer and needed to derive loss estimates from the model, and any variables which a licensed user is authorized to set in implementing the model.

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed examples of completed Attachment A forms.

5.2 Meteorological Standards – ***Peter Ray, 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

Pro Team Comments:

All standard units were used.

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 145)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year. Appropriate conversions are used.

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 shall be taken from the Tropical Prediction Center/National Hurricane Center (TPC/NHC) document *Tropical Cyclones of the North Atlantic Ocean, 1871-1998* updated through the 1999 hurricane season or later. 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 (pages 100-103)
Reference: Module 3, Section I (page 133)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

AIR provided evidence that the Atlantic Tropical Cyclone Model V3.2.0, Clasic/2 V1.02.0130 storm set matches that provided by the Commission.

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 97-103)

Reference: Module 3, Section I (page 133)
Reference: Standard 5.6.1 (pages 53-55)

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

Pro Team Comments:

The low pressure limit of the pressure at distribution is distributed among adjacent values.

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	≥ 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 133-134)
Reference: Standards 5.6.1 and 5.6.2 (pages 53-55)

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

Pro Team Comments:

5.2.6 Hurricane Probabilities

Modeled hurricane probabilities shall reasonably match the historical record through 1999 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 86)
Reference: Module 1, Section II, B.7 (pages 100-102)
Reference: Module 3, Section I (page 133)
Reference: Standards 5.6.1 and 5.6.2 (pages 53-55)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed smoothed distribution and their fit to historical data.

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 97)
Reference: Module 1, Section II, B.7-8 (pages 100-103)
Reference: Module 3, Section 1, #2 (page 134)
Reference: Module 3, Section 1, #8 (page 137)
Reference: Standards 5.6.1 and 5.6.2 (pages 53-55)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed overlay plots of fitted distributions to histograms of historical data and goodness-of-fit assessments.

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 98-99)
Reference: Module 3, Section I (page 133)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team was shown land friction maps to assess the USGS Land Use Land Cover database.

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 (pages 97-98)
Reference: Module 3, Section I (page 133)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

AIR demonstrated to the Professional Team their compliance within 20% of the Kaplan/Demaria filling rate model.

5.3 Vulnerability Standards – *John Pepper, Leader*

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 81-84)
Reference: Module 3, Section III (page 146)
Reference: Standard 5.6.1 (page 53)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change.

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 (page 146)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change.

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 (page 146)

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

Pro Team Comments:

No change.

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 78-81)
Reference: Module 3, Section III (page 146)

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

Pro Team Comments:

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 (pages 146-147)
Reference: Module 3, Section III, #6 (page 148)

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

Pro Team Comments:

No change.

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 151-152)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

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

Pro Team Comments:

The Professional Team was shown a presentation on mitigation methodology.

Individual Risk Methodology:

- Follows a logic-based approach in combining multiple parameters to develop a modified damage function
- Considers both structural and non-structural damage
- Allows study of mitigation effects including retrofitting

Shown the following documentation:

- Wind Resistance Categorization of Buildings with a Knowledge Based System by D.A. Smith, K.C. Mehta, J.R. McDonald, and R.H. Cheshire

- Building Wind Damage Prediction and Mitigation Using Damage Bands by Christian O. Unanwa and James R. McDonald
- Chart on Mitigation Analysis for Residential Wood Frame
- Dissertation in Civil Engineering titled A Model For Probable Maximum Loss in Hurricanes by Christian O. Unanwa, M.Sc., M.S.C.E., Texas Tech University
- Individual Risk Characteristics in Clasic/2™ - Wind for Residential:
  Construction Type, Roof Geometry, Roof Pitch, Roof Anchorage, Roof Covering, Roof Covering Attachment, Roof Deck, Roof Deck Attachment, Roof Age, Window Protection, Glass Type, Glass Percent, Wall Type, Wall Siding Type, Tree Exposure, Small Debris, Large Missiles, Wall Attached Structures, Exterior Doors, Number of Floors, Building Condition, Occupancy, Age, Appurtenant Structures, Roof Attached Structures, Internal Partition Walls, Building Foundation Connection

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 86-88)
Reference: Module 1, Section II, A.3-5 (pages 93-96)
Reference: Module 3, Section IV (page 149)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No changes from last 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 78)
Reference: Module 1, Section I, A.10 (page 85)
Reference: Module 1, Section I, C.1.c (pages 89-90)
Reference: Module 3, Section III, #3 (pages 146-147)

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

Pro Team Comments:

AIR does not use modification factors to the actuarial functions.

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 86-88)
Reference: Module 1, Section I, C.1.a (page 89)
Reference: Module 3, Section III, #2 (page 146)
Reference: Module 3, Section V (page 157)
Reference: Module 3, Section VII (page 168)

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

Pro Team Comments:

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 85)
Reference: Module 1, Section I, B.4 (pages 86-88)
Reference: Module 1, Section II, A.3-4 (pages 93-95)
Reference: Module 3, Section IV (page 149)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team reviewed examples of completed Attachment A forms.

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.

Reference: Module 1, Section I, C.1.a (page 89)
Reference: Module 3, Section III, #2 (page 146)
Reference: Module 3, Section VII (page 168)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team reviewed output reports to verify that the demand surge option had not been selected. The default is for the demand surge to be turned off. Output forms show if the damage function was turned on. Reviewed examples of Attachment A for verification.

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 96)

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

Pro Team Comments:

Loss costs are based upon 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. If the model considers the presence of fixtures or construction techniques designed for hazard mitigation, then the loss costs cannot increase above those in the absence of such measures, all other factors held constant.

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

7. If the model considers the quality of building codes and enforcement, then loss costs cannot increase as the quality 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 89)
Reference: Module 3, Section V, #2 (pages 157-160)
Reference: Module 3, Section V, #5 (pages 161-162)
Reference: Module 3, Section VII (page 168)

Proprietary: Some Proprietary
Verified: Yes

Pro Team Comments:

Reviewed examples of Attachment G and color coded maps. No changes from last year.

5.4.8 Deductibles

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

Reference: Module 1, Section I, B.3 (page 86)
Reference: Module 3, Section IV, #1-#2 (pages 149-150)
Reference: Standard 5.6.1 (pages 53-55)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Only minor revisions to the function itself this year, reintervaled the distribution. The only change was the low interval, no formula change, no distribution change. Made the change in order to be compatible with a more efficient numerical algorithm.

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 151)
Reference: Module 3, Section IV, #7 (pages 152-153)
Reference: Standard 5.6.1 (pages 53-55)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team reviewed client data in support of plots.

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 152)
Reference: Standard 5.6.1 (pages 53-55)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team was shown client data in support of generic plots. Difference from last year in that they used a distribution to get the mean. Average change was 1.4% lower on coverage D losses only.

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 I, C.1.b (page 89)
Reference: Module 3, Section III, #3 (pages 146-147)
Reference: Standard 5.6.1 (pages 53-55)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed by Pro Team, still performed the same way as last year.

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.

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed mitigation factors incorporated in Vulnerability Standards section.

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 154-156)
Reference: Module 3, Section V, #2 (pages 157-160)
Reference: Standard 5.6.2 (page 55)

Proprietary: No
Verified: Yes

Pro Team Comments:

Information provided with eight new storm combinations.

5.4.14 Comparison of Estimated Hurricane Loss Costs

The model shall provide the annual average 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 Funds (FHCF) aggregate 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 (page 136)
Reference: Module 3, Section I, #10 (page 140)
Reference: Module 3, Section V, #2 (pages 157-160)
Reference: Module 3, Section V, #4 (page 179)
Reference: Standard 5.6.2 (page 55)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed statistical comparison details by storm.

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.

Reference: Module 3, Section V, #4-#5 (pages 161-162 & 179)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed responses to Pro Team pre-visit letter.

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 111-113)
Reference: Standard 5.6.2 (page 55)

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

Pro Team Comments:

5.5 Computer Standards – ***Paul Fishwick, Leader***

AIR's General Comments on Changes:

In the past the hurricane model has been implemented on a series of Fortran programs running on Unix workstations in-house. The legacy code dates back to 1985-87 and is modified each year. The users of the legacy code had to be specially trained in-house and clients were not able to run the models at their locations. The need to produce software that could be run off-site led to the development of their current software, CLASIC/2™, which is usable by people outside of the company.

The CLASIC/2™ software is usable for the hurricane model and other catastrophe and risk models. It was designed to be generic enough to allow customers and users to apply various levels of insurance coverage, reinsurance policies, etc.

Outputs generated this year were run in CLASIC/2™ and compared to the Unix generated outputs for verification.

5.5.1 Primary Document Binder

A primary document binder 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.

Reference: Module 1, Section I (page 59)
Reference: Module 1, Section II (page 92)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed AIR's primary document binder which contained fully documented sections for each computer standard.

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 (page 59)
Reference: Module 1, Section II (page 92)
Reference: Module 3, Section VI, #3 (page 167)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed:

1. AIR Tropical Cyclone Model
2. Software Requirements Specification (SRS)

5.5.3 Component Design

The modeler shall document detailed computer-printed diagrams for control and data flow, and a schema for all data files along with field type definitions. Each network diagram shall contain components, arcs, and labels. At the topmost design level, detailed input and output interface specifications, including data types, shall be specified for each of the model's components.

Reference: Module 1, Section I (page 59)
Reference: Module 1, Section II (page 92)

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

Pro Team Comments:

Reviewed:

1. CLASIC/2™ System Architecture
2. Model Framework Documentation
3. Model Flow Chart

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 (page 59)
Reference: Module 1, Section II (page 92)

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

Pro Team Comments:

Reviewed:

1. Model Classes Documentation
2. Model Datafiles Documentation

5.5.5 Software Verification

The modeler shall employ verification procedures, such as code inspections, reviews, and walkthroughs, sufficient to demonstrate code correctness. The code shall contain sufficient logical assertions or flag-triggered output statements to test the correct values for key variables as they are modified.

Reference: Module 1, Section I (page 59)
Reference: Module 1, Section II (page 92)

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

Pro Team Comments:

Reviewed the verification procedures.

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 (page 59)
Reference: Module 1, Section II (page 92)
Reference: Standards 5.6.3 and 5.6.4 (pages 56-57)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed:

1. Software Design Specifications (SDS) – Screenshots
2. CLASIC/2™ Testware Library
3. GUI – Testing Guidelines
4. Unit Test sample documentation

5.5.7 Software Maintenance and Revision

The modeler shall specify all policies and procedures used to maintain the software. The modeler shall use source revision software to track code modifications.

Reference: Module 1, Section I (page 59)
Reference: Module 1, Section II (page 92)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed:

1. Microsoft Sourcesafe online documentation
2. Policy Statement

Current Versions:

1. Hurricane Model: Atlantic Tropical Cyclone Model V3.2.0
2. Comprehensive Software: CLASIC/2™ V1.02.0130

5.5.8 User Documentation

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

Reference: Module 1, Section I (page 59)
Reference: Module 1, Section II (page 92)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed:

1. CLASIC/2™ Reference Manual
2. CLASIC/2™ User Manual

5.6 STATISTICAL STANDARDS – *Mark Johnson, Leader*

5.6.1 Comparison of Historical and Modeled Results

In situations where a modeler uses historical data to develop a modeled counterpart, the modeler shall demonstrate the goodness-of-fit of the modeled results to the historical data using accepted scientific and statistical methods.

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed details of goodness-of-fit tests.

5.6.2 Characterizing Uncertainty

In cases where a statistical estimate is given, the modeler shall also provide an assessment of the attendant uncertainty.

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed several instances of standard errors associated with estimates.

5.6.3 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. Statistical techniques used to perform sensitivity analysis shall be explicitly stated and results demonstrated in graphical format.

Reference: Module 1, Section II, B.13-15 (pages 108-110)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team was shown additional details on the design and analysis of the sensitivity study. Focus was on answering questions based upon the submission and additional material presented to the professional team.

Reviewed Rabinowitz and Steinberg, Seismic Hazard Sensitivity Analysis: A Multi-Parameter Approach, 1991

5.6.4 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. Such an analysis will identify and quantify the input parameters that impact the uncertainty in model output when the input parameters are simultaneously varied. Statistical techniques used to perform uncertainty analysis shall be explicitly stated and results demonstrated in graphical format.

Reference: Module 1, Section II, B.13-15 (pages 108-110)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The methods used for propagating uncertainty through to the loss costs was reviewed.