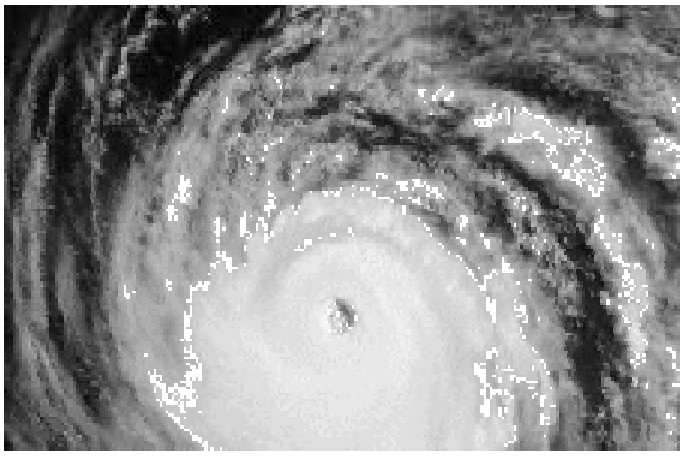
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Audit Report

Applied Research Associates, Inc. (ARA)

On-Site Review
April 25, 2001

On April 25, 2001, the Professional Team visited on-site at Applied Research Associates, Inc.(ARA) in Raleigh, North Carolina. The following people participated in the review:

ARA

Lawrence A. Twisdale, Ph.D., P.E., Principal
Peter J. Vickery, Ph.D., Senior Scientist
Srinivas R. Kadasani, M.S., Staff Scientist II
Kevin Z. Huang, Ph.D., Senior Engineer II
Peter F. Skerlj, M.E.Sc., B.E.Sc., Scientist
Michael A. Young, M.E. Sc., Scientist
Jason J-X. Lin, Ph.D., Senior Scientist
Chris Driscoll, B.S., Scientist
Marshall B. Hardy, B.S., M.S., Staff Scientist
Francis M. Lavelle, Ph.D., P.E., Principal Engineer
Reddy Kadasani, M.S., Staff Scientist II
Douglas J. Collins, FCAS, MAAA, Principal, Tillinghast-Towers Perrin (via phone)

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. ARA gave a brief presentation of changes to HURRLOSS Version 2.0.

Physical Damage Model:

- Weaker roof tiles used (yields higher losses at low wind speeds)
- Window resistance (to missiles) reduced
- Changed some building stock parameters (roof deck attachment and shutters)
- Mobile home model damage/loss unchanged, but tie-down fraction increased

Loss Given Physical Damage Model:

- No changes

Terrain:

- Corrected an error in the mapping of terrain

Climate Model – It was noted that the changes to the climate model did not really produce any significant change from the 1999 submission:

- Updated data to include 1999 storms
- Placed limits on heading and central pressure changes in a time step
- Updated Rmax model with more recent data

Insurance Data:

- Corrected an error in reading 1998 portfolio values
- Added one more comparison

New Studies:

- Performed sensitivity and uncertainty studies
- Performed more statistical tests on hurricane characteristics
- Kaplan-DeMaria redone using new Rmax model
- Hurricane characteristics table (in submission) changed to reflect the randomness in the inputs (rather than performing a simple deterministic calculation)

Zip Codes:

- Updated to use 2000 shape files

The definition of by-passing storm does not effect the loss costs generated by the HURLOSS model.

The total losses presented in last year's Form C should be divided by four.

This year's submitted Form E was run as having the entire portfolio modeled as single story wood rather than a mixture of wood/masonry/unknown and mobile home. An updated Form E with the correct mixture of wood/masonry/unknown and mobile home was provided to the Professional Team.

An example of sensitivity and uncertainty studies (effect on AAL and losses for various return periods); including:

- Damage Function uncertainty
- Terrain uncertainties
- Hurricane risk uncertainties

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

Pro Team Comments:

The model regarding flood and storm surge did not change from 1999. It is possible for the flood and storm surge to be turned off.

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 2-3 thru 2-8)
Reference: Module 2, Section I, #5 (pages 2-9 & 2-10)

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

Pro Team Comments:

Reviewed resume of Francis M. Lavelle, Ph.D.

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 1-1)
Reference: Module 1, Section I, A.9 (page 1-8)

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

Pro Team Comments:

ARA demonstrated their written policy has been functional since the previous review. Two specific instances involving changes from 1999 were shown to be handled appropriately.

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 1-16)
Reference: Module I, Section II, B.13-15 (page 1-17)
Reference: 5.5.3 (page 23)

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

Pro Team Comments:

The changes in the model did not lead to any problems with this standard.

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 3-23)
Reference: Module 3, Form A (page 3-24)

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

Pro Team Comments:

Reviewed maps showing the zip code boundaries and the associated geographic centroids. Further resolution for terrain level data was reviewed.

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 1-11)

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

Pro Team Comments:

Everything we looked at during the on-site review was clearly defined.

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

Pro Team Comments:

Reviewed color-coded maps of the wind speed for return period gust winds.

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:

The Professional Team was shown examples of “ARA HURLOSS Model Study Disclosure Summary” that shows the elements that are disclosed.

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:

In reviewing material throughout the day, they used all the appropriate measures.

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 3-13)

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

Pro Team Comments:

Internal calculations using peak gust wind converted to one minute sustained wind as appropriate.

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 (page 1-15)
Reference: Module 3, Section I (page 3-1)

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

Pro Team Comments:

ARA provided evidence that the ARA Version 2.0 storm set matches that provided by the Commission for the purpose of computing loss costs.

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 (page 1-13 thru 1-15)
Reference: Module 3, Section I (page 3-1)
Reference: Standard 5.6.1 (page 25)

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

Pro Team Comments:

Consistent with the data documented in scientific literature.

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 (page 3-1)
Reference: Standards 5.6.1 and 5.6.2 (pages 25 & 26)

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 1-9)
Reference: Module 1, Section II, B.7 (page 1-15)
Reference: Module 3, Section I (page 3-1)
Reference: Standards 5.6.1 and 5.6.2 (pages 25 & 26)

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

Pro Team Comments:

No changes from last year other than the simulated change and the statistical issues.

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 1-13)
Reference: Module 1, Section II, B.7-8 (page 1-15)
Reference: Module 3, Section 1, #2 (page 3-1)
Reference: Module 3, Section 1, #8 (page 3-4)
Reference: Standards 5.6.1 and 5.6.2 (pages 25 & 26)

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

Pro Team Comments:

The Professional Team 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 1-13 & 14)
Reference: Module 3, Section I (page 3-1)

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

Pro Team Comments:

The Professional Team was shown land friction maps to assess the Florida Water Management District's Land Use land Cover database and reviewed specific zip codes.

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 1-13)
Reference: Module 3, Section I (page 3-1)

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

Pro Team Comments:

ARA 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 (page 1-8)
Reference: Module 3, Section III (page 3-14)
Reference: Standard 5.6.1 (page 25)

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

Pro Team Comments:

John Pepper met separately with his counterparts and reviewed the derivation of the model as well as the input and a sample run.

A basic overview of vulnerability functions development, validation was given with an emphasis on computing damage to loss as well as a damage walk-through animation.

Material reviewed:

- Florida Counties DOQQ's Notebook
- Analysis of Hurricane Windborne Debris Impact Risk for Residential Structures: Part II by Peter Vickery, Jason Lin, and Larry Twisdale
- Variability of Low Building Wind Loads by Tat Chiu Eric Ho
- Various data concerning ASCE pressure coefficients versus ARA's pressure coefficients on both Gable and Hip Roofs
- Natural Ventilation in Low-Rise Buildings by Catherine Karakatsanis
- The Boundary Layer Wind Tunnel Laboratory by Jason Lin and D. Surry
- Wind Loads on Low Buildings with 4:12 Gable Roofs by Peter Case
- Thesis titled Wind Tunnel Modeling of Low Rise Structures in a Validated Open Country Simulation by Joseph S. Monroe
- Wind Loads on the Aylesbury Experimental House: A Comparison Between Full Scale and Two Different Scale Models by Peter Vickery
- HAZUS Wind Loss Estimation Methodology by Applied Research Associates
- Florida Building Construction Characteristics
- Building Component Models (Loads)
- Sensitivity Analysis of Expected Hurricane Loss Costs Estimates, a paper to promote understanding of loss cost sensitivities by Larry Twisdale, Jason Lin, and Peter Vickery

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 3-14)

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

Pro Team Comments:

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 3-14)

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

Pro Team Comments:

50 mph peak gust.

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 1-7 & 8)
Reference: Module 3, Section III (page 3-14)

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

Pro Team Comments:

The data and assumptions were reviewed.

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 3-14)
Reference: Module 3, Section III, #6 (page 3-15)

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

Pro Team Comments:

ARA does not use modification factors in their vulnerability functions.

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 (page 3-17)

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:

ARA provided documentation on the following analyses:

- Roof Loads on a Single-Story Hip Roof House and ARA Loads versus ASCE Loads
- Roof Loads on a Single-Story Gable Roof House and ARA Loads versus ASCE Loads

Work for Florida Wind Association reviewed previously.

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 (page 1-9)
Reference: Module 1, Section II, A.3-5 (pages 1-12 & 13)
Reference: Module 3, Section IV (page 3-16)

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

Pro Team Comments:

The Professional Team reviewed the input file from an insurance company exposures and sensitivity analyses where ARA disregarded the negative and then reran using the negatives. Examined e-mail correspondence relating to ARA's resolution of data problems and interpretation of insurer losses.

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 1-7)
Reference: Module 1, Section I, A.10 (page 1-9)
Reference: Module 1, Section I, C.1.c (page 1-10)
Reference: Module 3, Section III, #3 (page 3-14)

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

Pro Team Comments:

ARA does not use modification factors to 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 (page 1-9)
Reference: Module 1, Section I, C.1.a (page 1-10)
Reference: Module 3, Section III, #2 (page 3-14)
Reference: Module 3, Section V (page 3-20)
Reference: Module 3, Section VII (page 3-24)

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

Pro Team Comments:

Doug Collins attested to the response given in 5.4.3 Pro Team examined methods used to develop 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 1-9)

Reference: Module 1, Section I, B.4 (page 1-9)
Reference: Module 1, Section II, A.3-4 (page 1-12)
Reference: Module 3, Section IV (page 3-16)

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

Pro Team Comments:

The Professional Team reviewed examples of insurer's inputs tied to identification of assumptions and methods in output from ARA Version 2.0.

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 1-10)
Reference: Module 3, Section III, #2 (page 3-14)
Reference: Module 3, Section VII (page 3-24)

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

Pro Team Comments:

ARA did not include demand surge in the model and did not do any damage surge studies.

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 1-13)

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

Pro Team Comments:

Vulnerability functions calculate loss costs expressed as insurable 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 1-10)
Reference: Module 3, Section V, #2 (page 3-20)
Reference: Module 3, Section V, #5 (page 3-22)
Reference: Module 3, Section VII (page 3-24)

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

Pro Team Comments

Discussions held on issues and looked at color-coded maps.

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 1-9)
Reference: Module 3, Section IV, #1-#2 (page 3-16)
Reference: Standard 5.6.1 (page 25)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Details and validation were presented showing how the changes are due to terrain adjustments and roof tiles impacts.

Doug Collins looked at the relativities and noticed that between 1%, 2%, and 5% a larger credit was given due to changes in mitigation devices and the effect of those on the smaller losses. He was convinced that the discussions he had and the data he was shown gave a plausible explanation to the changes in relativities and deductibles. He did not actually look at the terrain, but was satisfied in the terrain adjustments brought about the changes in relativities and deductibles.

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 3-17)
Reference: Module 3, Section IV, #7 (page 3-17)
Reference: Standard 5.6.1 (page 25)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The building and contents relativities did not change significantly. Pro Team viewed criteria used to calculate loss costs.

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 3-17)
Reference: Standard 5.6.1 (page 25)

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

Pro Team Comments:

No change. APS identical to last year.

Analysis between building loss costs and ALE from last year to this year show relativities are substantially the same.

Building and APS analysis shows difference in relativities from last year to this year – loss costs relativities for Building and APS the same from last year and this year.

Internal comparisons between model output and insurance company data – looked at the graphs of validation comparisons of insurance company loss data by storm and loss by wind speed of actual vs modeled plots.

Looked at the actual input from the insurance companies, not just the graphs.

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 1-10)
Reference: Module 3, Section III, #3 (page 3-14)
Reference: Standard 5.6.1 (page 25)

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

Pro Team Comments:

Some new data from FWUA surveys – most of the data did not change from last year.

FWUA building home inspection data was examined. Adjustments are consistent with findings.

Other data sources were the same as last year included some HUD reports, Housing Survey – series of 8 reports – purchased arial photography and looked at them.

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:

Looked at the objective information to determine if it was actuarially reasonable. Discussion of what is the actuarial aspect of this standard – assumptions of distributions by device type as well as the credit for those devices – credits are based on engineering data & analysis – found reasonable based on the info made available – looked at the distribution of the percentage of house with shutters in different parts of the state – 8 penny nails vs smaller nails, roof straps.

All calculations performed with engineering modeling approaches.

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 3-18 & 19)
Reference: Module 3, Section V, #2 (page 3-20)
Reference: Standard 5.6.2 (page 26)

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

Pro Team Comments:

Viewed an updated chart from last year with the corrections due to terrain and building stock adjustments.

Viewed series of 12 or 13 plots by company and storm that show the actual and modeled loss ratios by wind speed and overall ratios of modeled to actual losses for that data set using the current model and the previous model.

Changes in loss costs were reasonable due to the changes in terrain and other criteria.

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 3-3)
Reference: Module 3, Section I, #10 (page 3-7)
Reference: Module 3, Section V, #2 (page 3-20)
Reference: Module 3, Section V, #4 (page 3-32)
Reference: Standard 5.6.2 (page 26)

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

Pro Team Comments:

Reviewed statistical comparison details close to the estimates that came out last year. Analysis determined this was not unusual – samples a large number of 100 year periods to see what the variability would be in 100 years of actual events. Found differences to be reasonable.

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 3-22 & 3-32)

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

Pro Team Comments:

Looked at the overall changes and considered them reasonable based on the overall changes to the model.

Pro Team viewed changes in light of adjustments made for terrain and building stock.

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 1-18 thru 20)
Reference: Standard 5.6.2 (page 26)

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

Pro Team Comments:

No change.

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

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 1-1)
Reference: Module 1, Section II (page 1-11)

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

Pro Team Comments:

The Primary Document Binder references and organizes the following document binders:

HURLOSS RISK ANALYSIS SUITE documentation

Volume	Binder Section	Title
0		Primary Documents Binder
	0-A	**Primary Documents Binder**
I		Hurricane Simulation Model
	I-A	**LIFESIMi Model**
	I-B	**Hurricane Model:** Validation Results/ Statistical Tests
	I-C	**Hurricane Model:** Verification/Testing Results
	I-D	**Hurricane Model:** Sensitivity and Uncertainty Studies
	I-E	**Windfield Model**
II		Individual Building Damage & Loss Model
	II-A	**Building Component Models (Loads)**
	II-B	**Individual Building Damage Model Part 1**
	II-C	**Individual Building Damage Model Part 2**
	II-D	**Building Damage Comparisons FHC99 vs. FHC00**
	II-E	**Individual Ground-Up Building Loss**
III		Portfolio Analysis Model
	III-A	**Actuarial and Aggregation Models**
		Actuarial Issues (Deductible, A, B, C, D, Value Ratios, Bus. Type)
		Aggregation
	III-A2	**Florida Building Construction Characteristics**

III-B Terrain Database (by Zip Code)
III-C DOQQ's
III-D HURLOSS

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 1-1)
Reference: Module 1, Section II (page 1-11)
Reference: Module 3, Section VI, #3 (page 3-23)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

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 1-1)
Reference: Module 1, Section II (page 1-11)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team reviewed the primary document binder and the supplemental documentation binders for each of the major components of the model.

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 1-1)
Reference: Module 1, Section II (page 1-11)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The Professional Team reviewed the source code in C++ and Fortran.

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 1-1)
Reference: Module 1, Section II (page 1-11)

Proprietary: Yes
Verified: Yes
Pro Team Comments:

Reviewed ARA's software 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 1-1)
Reference: Module 1, Section II (page 1-11)
Reference: Standards 5.6.3 and 5.6.4 (page 26)

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

Pro Team Comments:

Reviewed graphs and tables indicating the testing results in the component documentation binders.

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 1-1)
Reference: Module 1, Section II (page 1-11)

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

Pro Team Comments:

5.5.8 User Documentation

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

Reference: Module 1, Section I (page 1-1)
Reference: Module 1, Section II (page 1-11)

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

Pro Team Comments:

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

Pro Team Comments:

The Professional Team reviewed the statistical tests performed showing modeled versus observed plots, hurricanes by category, wind and central pressure by every milepost. A notebook containing detailed results was reviewed.

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

Pro Team Comments:

Uncertainty studies were used to characterize the uncertainty in the estimate of the AAL and losses for various return periods at the zip code level associated with uncertainty in:

(i) the hurricane wind climate
(ii) the definition of the loss function in a zip code
(iii) the estimation of the average or effective value of Zo in the zip code.

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 (page 1-17)

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

Pro Team Comments:

The Professional Team was shown a paper to promote understanding of loss cost sensitivities entitled "Sensitivity Analysis of Expected Hurricane Loss Costs Estimates" written by Lawrence A. Twisdale, Jason Lin, and Peter J. Vickery. We also reviewed "Sensitivity and Uncertainty Studies".

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 (page 1-17)

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

Pro Team Comments:

The Professional Team was shown ARA's study and it was discussed in depth.