

Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report 2005 Standards

Applied Research Associates, Inc.

On-Site Review
April 6 & 7, 2006

On April 6&7, 2006 the Professional Team visited on-site at Applied Research Associates, Inc. (ARA) in Raleigh, North Carolina. The following individuals participated in the review.

ARA

Douglas Collins, Actuarial Consultant (via phone)
Chris Driscoll, Staff Scientist
Francis M. Lavelle, Ph.D., P.E., Principal Engineer
Rick Pearson, Software Developer
Peter J. Vickery, Ph.D., P.E., Principal Engineer

Professional Team

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

The review began with introductions and an overview of the audit process. ARA gave a presentation explaining the changes in the 2006 model (HurLoss 3.4) as follows:

- Updated the ZIP Code database
- Revised definition of an event
- Application of annual deductibles

Discussed and reviewed the following corrections to be made in the submission that will be provided to the Commission prior to the May 16-18, 2006 meetings.

1. Page 18, G-1.2, revised for correct Vickery reference to be consistent with M-5.
2. Page 19, G-1.2, revised to correct typographical error in last sentence on page.
3. Page 25, G-2.2A, Table 1 revised to correct degree for Francis M. Lavelle.
4. Page 31, G-2.3A, revised to include meteorological review by Dr. Steven Businger.
5. Pages 38-42, Forms G-1 through G-5, with updated signatures after revisions made to the original February 28, 2006 submission.
6. Page 47, M-2.1, revised to include Vickery reference, dates on all databases listed, and more specification on HRD Wind Analyses.
7. Page 51, M-3.3, revised to include all modeled characteristics of the upper limit wind speed storm produced by the model.
8. Page 52, M-4.A, revised to remove last sentence in second paragraph on historical database of radii of hurricane force winds.
9. Page 62, Form M-1, revised to correct Florida By-Passing in table header.
10. Pages 79-82, Form V-2, revised to correct missing values in 150mph column.
11. Pages 102-108, Tables 4a-4g, revised to include missing page numbers.
12. Pages 113-118, Forms A-3, A-4, and A-5, hard copies missing from original submission.
13. Page 115, Form A-4, revised to correct 1912, 1916 storms.
14. Page 169, S-2.3, revised to correct figure reference.
15. Page 179, S-6.1, revised to update Figure 37.

Reviewed and discussed additional information ARA anticipates including in their presentation to the Commission at the May model review meetings including the Trade Secret List information.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

1. The main intent of the audit is to determine the capabilities of the model and to assess its implementation for purposes of Florida projected loss costs. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.
2. Software located within the model, used to compile data used by the model, used to validate the model, and used to project model loss costs will be reviewed interactively.
3. Databases or data files relevant to the modeler's submission will be reviewed.

Pre-Visit Letter

2. G-1.2, page 19 – Clarify “has been is being” under Software, Hardware, and Program Structure.

Verified: YES, ~~Contingent upon additional documentation provided to the Commission~~ Additional documentation received

Professional Team Comments:

Revised response to be provided to the Commission:

- G-1.2, pages 18 & 19, correct (1) Vickery reference under Hurricane Hazard Model to be consistent with Standard M-5 and (2) typographical error under Software, Hardware, and Program Structure.

Revised response to G-1.2 received and reviewed by the Professional Team.

G-2 Qualifications of Modeler Personnel and Consultants

- A. Model construction, testing, and evaluation shall be performed by modeler personnel or consultants who possess the necessary skills, formal education, or experience to develop the relevant components for hurricane loss projection methodologies.**
- B. The model or any modifications to an accepted model shall be reviewed by either modeler personnel or consultants in the following professional disciplines: structural/wind engineering (licensed Professional Engineer), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall be signatories on Forms G-1 through G-6 as applicable and shall abide by the standards of professional conduct if adopted by their profession.**

Audit

1. The professional vitae of modeler personnel and consultants responsible for the current model and information on their predecessors if different than current personnel will be reviewed. Background information on individuals providing testimonial letters in the submission shall be provided.
2. Forms G-1, G-2, G-3, G-4, G-5, G-6, and all independent peer reviews of the model will be reviewed.
3. Discuss any known incidents where modeler personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

3. G-2, Disclosure 2.A, page 25 – Discuss former employees.
4. G-2, Disclosure 2.C, page 30 – Specify the process required in Standard C-5 within Figure 4.

Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received

Professional Team Comments:

Reviewed the verification process performed within and among each of the three main modules identified in the model workflow diagram in Figure 4 on page 30.

Reviewed ARA's quality assurance program applied to all model outputs for clients.

Reviewed correspondence with Doug Collins, actuarial consultant, regarding his review of the model. Reviewed documentation on the details of his review and questions asked for clarification.

Spoke with Doug Collins regarding his review of the model and the effect on loss costs from the changes implemented in the model during 2005.

Revised responses to be provided to the Commission:

- G-2.2A, Table 1, page 25, with correct degree for Francis M. Lavelle.
- G-2.3A, page 31, include meteorological review by Dr. Steven Businger.
- Forms G-1 through G-5, pages 38-42, with updated signatures after revisions have been made to the original February 28, 2006 submission and reviewed by modeler personnel.

Revised responses to G-2.2A, Table 1, G-2.3A and Forms G-1 through G-5 received and reviewed by the Professional Team.

G-3 Risk Location

- A. ZIP Codes used in the model shall be updated at least every 24 months using information originating from the United States Postal Service. The United States Postal Service issue date of the updated information shall be reasonable.***
- B. ZIP Code centroids, when used in the model, shall be based on population data.***
- C. ZIP Code information purchased by the modeler shall be verified by the modeler for accuracy and appropriateness.***

Audit

1. Provide geographic displays for all ZIP Codes. The location of specific centroids will be reviewed.
2. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.

Pre-Visit Letter

1. ARA Checklist Item 3, page 11 – Provide materials referenced to be shown to the Professional Team.
 - Page 33, G-3.C – Maps showing the zip code boundaries and the associated centroids will be available to the Professional Team.

5. G-3, page 33 – Be prepared to go over the entire process of ZIP Code updating, testing, verification, and how this updating might affect other ZIP Code-based databases.

Verified: YES

Professional Team Comments:

Reviewed the process of updating, testing, and verifying the ZIP Code database.

Reviewed ZIP Code boundary maps illustrating changes in the boundaries, movement of centroids, and changes in the surface roughness factors due to centroid movement.

Discussed new ZIP Code database vendor and reviewed list of ZIP Codes that changed. Reviewed the user's guide provided by the vendor.

Discussed validation for distance inland and ZIP Code terrain comparison.

G-4 Submission Specifications*

*(*Significant Revision)*

- A. All units of measurement for model inputs and outputs shall be clearly identified.**
- B. All model outputs of length, wind speed, and pressure shall be in units of statute miles, statute miles per hour, and millibars, respectively.**
- C. Unless otherwise specified, wind fields generated by the model shall be used for completing relevant Forms and Tables in the submission.**

Audit

1. The appropriateness of the units of measurement will be reviewed.
2. The information used in completing Forms and Tables in the submission will be reviewed.

Verified: YES

Professional Team Comments:

Appropriate units of measurement were verified throughout the review process.

Reviewed numerous data sources and processes for completing Forms and Tables in the submission, with particular reference to the underlying modeled wind field.

G-5 Independence of Model Components

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

Audit

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

Verified: YES

Professional Team Comments:

The independence of the meteorology, vulnerability, and actuarial components and their theoretical soundness was verified in the course of the review.

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

(*Significant Revision)

For validation of landfall and by-passing storm frequency in the stochastic storm set, the modeler shall use the latest updated Official Hurricane Set or the National Hurricane Center HURDAT as of June 1, 2005 or later. Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

Audit

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

Pre-Visit Letter

6. Be prepared to describe how multiple event years are treated in the model. Is there any feedback to surface roughness?

Verified: YES

Professional Team Comments:

Verified that there was no feedback to surface roughness for multiple events.

Verified that the modeler's Base Hurricane Set includes storms in HURDAT through the 2004 season, and that HURDAT information back to 1886 is added for development of selected storm characteristics.

M-2 Hurricane Characteristics

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

Audit

1. All hurricane characteristics used in the model will be reviewed.
2. Prepare graphical depictions of hurricane characteristics as used in the model. Describe and justify:
 - the data set basis for the fitted distributions,
 - the modeled dependencies among correlated characteristics in the wind field component and how they are represented,
 - the asymmetric nature of hurricanes,
 - the fitting methods used and any smoothing techniques employed.
3. The goodness-of-fit of distributions to historical data will be reviewed.
4. The modeler will present time-based contour animations (capable of being paused) of wind and pressure fields to demonstrate scientifically reasonable wind field characteristics.
5. The treatment of uncertainties associated with the conversion of gradient winds to surface winds will be compared with currently accepted literature. Variation of the conversion factor with storm intensity will be reviewed.

6. All modeler-specific scientific literature provided in Standard G-1 will be reviewed to determine acceptability.
7. Identify all external data sources that affect model generated wind fields.

Pre-Visit Letter

7. M-2, page 46 – What are the meteorological parameters in your model that are most critical in terms of loss sensitivity? What is their relative importance and how is this assessed? Show example calculations of such an assessment.
8. M-2, page 46 – The analysis of far field pressure, P_{env} , in a recent report “suggests a value of 1011 or 1012 rather than the commonly used 1013 mb value.” However, when the analysis is further restricted to storms affected Florida, this conclusion is modified to be, “A case can be made that if a single value is to be used for P_{env} , 1010 mb or 1011 mb is more reasonable than 1013 mb.” What is the value of this parameter in the model and how does it vary? If this parameter does not vary, its effects will be wrapped into a shape or profile parameter. How is the variation of this profile parameter determined?
9. M-2, page 47 – Be prepared to discuss the assumed environmental pressure and radius to environment and how these vary with month, latitude, and longitude. What sensitivity and uncertainty analyses have been performed to test the model sensitivity to these variables?
10. M-2, Disclosure 3, page 48 – Be prepared to discuss the variation of the gradient to surface winds conversion factor. Describe the process for simulating the difference in winds at different heights. This is equivalent to discussing the conversion from gradient to surface for this model.
11. M-2, Disclosure 4, page 48 – Be prepared to describe the basis for the ESDU (1982, 1983) models for atmospheric turbulence. For example, are these parametric models or deterministic dynamical models?
12. M-2, Disclosure 6, page 48 – Provide the rationale for the 1886 start date.
13. M-2, Disclosure 9, page 49 – Be prepared to discuss the treatment of hurricane intensity at and immediately after landfall.

Verified: ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

Professional Team Comments:

Discussed the meteorological variables in the model that are most critical to the characterization of hurricanes.

Reviewed the methodology used in applying the Holland B parameter in the wind field. Reviewed historical storms in this context.

Documentation reviewed:

- Vickery, P.J., Skerlj, P.F., and Twisdale, Jr., L.A. (2000b). “Simulation of Hurricane Risk in the U.S. Using an Empirical Track Model,” *Journal of Structural Engineering*, ASCE, Vol. 126, No. 10, October, pp. 1222-1237.
- Vickery, P.J. (2005). “Simple Empirical Models for Estimating the Increase in the Central Pressure of Tropical Cyclones after Landfall along the Coastline of the United States,” *Journal of Applied Meteorology*, December, pp. 1807-1826.

Reviewed environmental pressure and discussed the application of a constant far field pressure in the model and the sensitivity of loss cost to this value. Discussed future plans for sensitivity studies on environmental pressure.

Reviewed the conversions of wind speeds in the model using the ESDU (Engineering Sciences Data Unit) model for atmospheric turbulence.

Discussed the rationale for inclusion of HURDAT beginning in 1886.

Discussed the treatment of hurricane intensity at and immediately after landfall.

Reviewed hurricane intensity at and after landfall and adjustments made to overland wind speeds using the filling model described in Vickery, 2005 referenced above.

Revised response to be provided to the Commission:

- M-2.1, page 47, include (1) Vickery, 2005 reference, (2) dates on all databases listed, and (3) more specification on HRD Wind Analyses.

Revised response to M-2.1 received and reviewed by the Professional Team.

M-3 Landfall Intensity

Models shall use maximum one-minute sustained 10-meter wind speed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm Set used to develop landfall strike probabilities as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter 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:

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

Audit

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

Pre-Visit Letter

14. M-3, Disclosure 3, page 51 – The answer and Table 2 do not appear to respond to this disclosure. Based on the list of storm parameters used in wind speed calculations elsewhere in the report, all modeled characteristics have not been provided. Provide the method for converting 1-minute sustained winds from peak gust.

Verified: ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

Professional Team Comments:

Reviewed the modeled characteristics from the upper limit wind speed storm produced by the model.

Reviewed the computer code for inclusion and exclusion of simulated storms in the computation of loss costs.

Revised response to be provided to the Commission:

- M-3.3, page 51, revised to include all the modeled characteristics from the upper limit wind speed storm produced by the model.

Revised response to M-3.3 received and reviewed by the Professional Team.

M-4 Hurricane Probabilities

- A. Modeled probability distributions for hurricane intensity, forward speed, radii for maximum winds, and storm heading shall be consistent with historical hurricanes in the Atlantic basin.**
- B. Modeled hurricane probabilities shall reasonably reflect the Base Hurricane Storm Set used for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).**

Audit

1. Modeled probabilities are compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical hurricane frequencies for the four regions of Florida and overall as provided in Form M-1 will be reviewed.
2. Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.
3. Describe and support the method of selecting stochastic storm tracks.
4. Describe and support the method of selecting storm track strike intervals. If strike locations are on a discrete set, show the landfall points for major metropolitan areas in Florida.
5. Provide any modeler specific research performed to develop the functions used for simulating model variables or to develop databases.

Verified: YES, ~~Contingent upon additional documentation provided to the Commission~~ Additional documentation received

Professional Team Comments:

Revised responses to be provided to the Commission:

- M-4.A, page 52, revised to remove last sentence in second paragraph, “No database exists describing historical records of radii of hurricane force winds.”
- Form M-1, page 62, with correct heading for Florida “By-Passing”.

Revised responses to M-4.A and Form M-1 received and reviewed by the Professional Team.

M-5 Land Friction and Weakening*

(*Significant Revision due to Disclosures)

A. The magnitude of land friction coefficients shall be consistent with currently accepted scientific literature relevant to current geographic surface roughness distributions and shall be implemented with appropriate geographic information system data.

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

Audit

1. Identify other variables in the model that affect over land wind speed estimation.
2. Maps depicting land friction effects are required. Describe the representation of land friction effects in the model. Describe the variation in decay rate over land used in the model.
3. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.
4. Transition of winds from over water to over land (i.e. landfall) will be reviewed.
5. Form M-2 will be reviewed.

Pre-Visit Letter

15. M-5, Disclosure 4, page 56 – Justify the timeliness of the land use land cover data cited in this response.
16. M-5, Disclosure 5, page 56 – Be prepared to show agreement between observations and windfields *generated with your standard model* for historical storm cases over land. It is acceptable to adjust the observed winds to the same averaging time assumed by the model, provided the same method of adjustment is used for all comparisons. It is not acceptable to refer to the Kaplan DeMaria decay rate without observed winds for the storms in question. The spatial distribution of winds should be compared for individual storms. Be prepared to explain any instances of poor agreement with reference to the meteorology of the case being considered. Review Figure 8 on page 57 with regard to decay rate model.
18. Form M-2, Figures 12 & 13, page 64 – Be prepared to discuss why the peak winds over Florida for the 100 year return period are so much weaker than the historical.

Verified: YES

Professional Team Comments:

Discussed the land use and land cover data source and the process for implementation in the model. Reviewed the timeliness of these data and the justification for use.

Reviewed the computer code for application of the roughness factor.

Discussed the method for adjusting wind speeds from open terrain.

Reviewed comparisons of modeled and observed peak gust wind speeds at several stations for 2004 storms Charley, Frances, Ivan, and Jeanne.

Reviewed comparisons of modeled and observed over land central pressure changes for Jeanne (2004).

Reviewed the computer code implementing the current filling model.

Reviewed variations in filling across Florida for two control storms in different regions.

Reviewed Form M-2 and discussed the differences in the modeled peak wind speeds versus the historical.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

1. Form M-3 and the modeler's sensitivity analyses provide the information used in auditing this Standard.
2. Justify the relationship between central pressure and radius of maximum winds.

Pre-Visit Letter

19. Form M-3, page 65 – Justify the use of 1013 mb far field pressure “in all cases”.

Verified: YES

Professional Team Comments:

Reviewed Form M-3 and the treatment of Rmax in the model. Discussed modeler's examination of historical Rmax data.

VULNERABILITY STANDARDS – Fred Stolaski, Leader**V-1 Derivation of Vulnerability Functions**

- A. Development of the vulnerability functions is to be based on a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. Any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, or historical data.***
- B. The method of derivation of the vulnerability functions shall be theoretically sound.***
- C. Any modification factors/functions to the vulnerability functions or structural characteristics and their corresponding effects shall be clearly defined and be theoretically sound.***
- D. Construction type and construction characteristics shall be used in the derivation and application of vulnerability functions.***
- E. In the derivation and application of vulnerability functions, assumptions concerning building code revisions and building code enforcement shall be reasonable and be theoretically sound.***
- F. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and additional living expense.***
- G. The minimum wind speed that generates damage shall be reasonable.***

Audit

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

- review. The basis for expert opinion and original site inspection reports should be available for review.
2. Copies of any papers, reports, and studies used in the development of the vulnerability functions should be available for review. Copies of all public record documents used may be requested for review.
 3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense should be available. The magnitude of logical changes among these items for a given wind speed shall be explained and validation materials should be available.
 4. Justify the construction types and characteristics used, and provide validation of the range and direction of the variations in damage.
 5. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement.
 6. Provide validation material for the disclosed minimum wind speed. Provide the computer code showing the inclusion of the minimum wind speed at which damage occurs.
 7. Describe how the duration of wind speeds at a particular location over the life of a hurricane is considered.
 8. Form V-1 will be reviewed.

Pre-Visit Letter

20. V-1, page 67 – Be prepared to describe any changes made to the vulnerability functions in the past five years based upon engineering site inspections, insurance company claim data, etc.
21. V-1.D, page 68 – Be prepared to discuss assumptions and validations as to construction types and characteristics plus quality of construction.
22. V-1, Disclosure 1, page 68 – Be prepared to describe the process and software used in the procedures provided in Figure 15.
23. V-1, Disclosure 2, page 69 – Most recent insurance data is from 1998. Discuss efforts to obtain more recent data.
24. V-1, Disclosure 5, page 70 – Be prepared to discuss the “number of categories or building classes in loss projection studies.” Provide cited examples to the Professional Team.
 - Examples of the number of categories or building classes considered in loss projection studies will be reviewed with the professional team.
25. Form V-1, page 74 – Be prepared to discuss and show how this form was prepared. Specifically describe the similarities and differences with last year’s submission. Discuss the closeness of values for frame and masonry in Part B.

Verified: YES

Professional Team Comments:

Verified no changes were made to the vulnerability functions in the past year.

Discussed plans to update the building stock distribution due to updates in the Florida Building Code (2001). Changes in damages to eaves and soffits were discussed.

Reviewed post-disaster surveys taken after Hurricane Charley. Discussed basis for selection of areas to be covered, composition of survey teams, and the information collected. Reviewed actual Hurricane Damage Survey Forms from a number of site inspections.

Discussed the process for updating the computer code for revisions to the vulnerability functions based on post-disaster site inspections including group approval.

Reviewed construction regions/eras and building stock distribution by region for wood frame.

Discussed the process used for developing building vulnerability functions. Reviewed examples of model buildings with different roof shapes.

Reviewed the computer code for computing roughness and missile source density statistics, estimated wall loads, updating internal pressure, and validation of pressure failure.

Reviewed building stock specific loss functions for various deductibles.

Reviewed the number of building classes used in loss projection studies and examples.

Discussed effect of multiple storms on building stock. Discussed duration of storms and effect of moisture as determined by the rainfall model. Reviewed increases in magnitude of wind pressure due to breach of structure envelope.

Documentation reviewed:

- Vickery, P.J., Lin, J., Skerlj, P. F., Twisdale, Jr., L.A., and Huang, K. (2006). "HAZUS-MH Hurricane Model Methodology. I: Hurricane Hazard, Terrain, and Wind Load Modeling," *Natural Hazards Review*, Vol. 7, No. 2, pp. 82-93, May.

Discussed results provided in Form V-1 and reviewed differences from previous submittal. Discussed reasons and logic for closeness of values for masonry and wood frame types.

V-2 Mitigation Measures*

(*Significant Revision due to Form V-2)

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

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

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

Audit

1. Form V-2 provides the information used in auditing this Standard.
2. Total effect on damage due to use of multiple mitigation measures will be reviewed and shown to be reasonable. Any variation in the change over the range of wind speeds for individual and multiple mitigation measures will be reviewed and shown to be reasonable.
3. Mitigation measures used by the model that are not listed as required in this Standard will be disclosed and shown to be theoretically sound and reasonable.

Pre-Visit Letter

26. Form V-2, pages 78-82 – Be prepared to discuss and show documentation on methods used to complete the form. Explain the values provided for Mitigated Structure at various wind speeds in relation to the sum of the individual Mitigation Measures added to the Base Structure. Explain missing entries for 150 mph wind speed. Explain zeros in Masonry Wall-Floor Strength.

Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received

Professional Team Comments:

Verified no changes to the methodology for mitigation features.

Reviewed percentage change in Form V-2 for damage rates at different wind speeds with mitigation features including roof covering, roof deck attachment, roof anchorage,

and window protection individually and then all four mitigation features together on the base structure.

Discussed values of zero difference in Form V-2 for all wind speeds for masonry structures in the wall strength items.

Revised response to be provided to the Commission:

- Form V-2, pages 79-82, corrected for missing values in the 150mph column.

Revised Form V-2 received and reviewed by the Professional Team.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs*

(*Significant Revision)

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

Audit

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

Pre-Visit Letter

27. A-1, Disclosure 1, page 83 – Review how the model implements this disclosure.

Verified: YES

Professional Team Comments:

Reviewed the definition of an event in the model and the handling of by-passing storms.

Discussed Doug Collins' review of how damage from modeled storms are excluded or included in the calculation of loss costs.

Discussed the verification process and reviewed comparisons of return period wind speeds for 2004 and 2005.

Reviewed regression tests for changes to ZIP Codes and event definition.

A-2 Underwriting Assumptions

- A. When used in the modeling process or for verification purposes, adjustments, edits, inclusions, or deletions to insurance company input data used by the modeler shall be based upon accepted actuarial, underwriting, and statistical procedures.***
- B. For loss cost estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) claim payment practices, and (4) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be reasonable and appropriate.***

Audit

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

Verified: YES

Professional Team Comments:

Discussed Doug Collins’ review of how insurer claims payment practices are considered in the model.

A-3 Loss Cost Projections

- A. Loss cost projections produced by hurricane loss projection models shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.***
- B. Loss cost projections shall not make a prospective provision for economic inflation.***
- C. Loss cost projections shall not explicitly include demand surge.***

Audit

1. Demonstrate how the presence of demand surge has been considered in any analysis where Hurricane Andrew losses are used for development or verification of the model or its output. Demonstrate how demand surge is considered in any other data used in the development or verification of the model.
2. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, and economic inflation.

Verified: YES

Professional Team Comments:

Verified that demand surge was not explicitly included in producing the loss costs.

Discussed Doug Collins' review and verification that expenses, risk loads, investment income, premium reserves, taxes, assessments, and profit margin are not included in loss costs.

A-4 User Inputs

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

Audit

1. Quality assurance procedures should include methods to assure accuracy of insurance data. Compliance with this Standard will be readily demonstrated through documented rules and procedures.
2. All insurer inputs and assumptions will be reviewed.

Pre-Visit Letter

1. ARA Checklist Item 3, page 11 – Provide materials referenced to be shown to the Professional Team.
 - Page 88, A-4.2 – Model input requirements are documented in the HurLoss User Manual, which will be made available to the Professional Team.

Verified: YES

Professional Team Comments:

Discussed quality assurance procedures for verifying the accuracy of insurance company data being used.

Reviewed the error log file where records with missing values are reported and then the missing value is provided or the record is removed from the analysis.

Discussed Doug Collins' review of assumptions made regarding inputs in the model.

A-5 Logical Relationship to Risk

- A. Loss costs shall not exhibit an illogical relation to risk, nor shall loss costs exhibit a significant change when the underlying risk does not change significantly.***
- B. Loss costs produced by the model shall be positive and non-zero for all valid Florida ZIP Codes.***
- C. Loss costs cannot increase as friction or roughness increase, all other factors held constant.***
- D. Loss costs cannot increase as the quality of construction type, materials and workmanship increases, all other factors held constant.***
- E. Loss costs cannot increase as the presence of fixtures or construction techniques designed for hazard mitigation increases, all other factors held constant.***
- F. Loss costs cannot increase as the quality of building codes and enforcement increases, all other factors held constant.***
- G. Loss costs shall decrease as deductibles increase, all other factors held constant.***
- H. The relationship of loss costs for individual coverages, (e.g., structures and appurtenant structures, contents, and loss of use/additional living expense) shall be consistent with the coverages provided.***

Audit

1. Graphical representations of loss costs by ZIP Code and county will be reviewed.
2. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.
3. Individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, A-5 and A-6 will be used to assess coverage relationships.

Pre-Visit Letter

31. Forms A-3, A-4, and A-5, page 113-118 – Hard copies missing in the submission booklets.

Verified: ~~YES, Contingent upon additional documentation provided to the Commission~~ **Additional documentation received**

Professional Team Comments:

Discussed Doug Collins' review on the changes in loss costs due to the recent updates in the model.

Discussed relationships between loss costs and construction quality/type, mitigation features, building codes and enforcement.

Revised responses to be provided to the Commission:

- Hard copies of pages 113-118, Forms A-3, A-4, and A-5 missing from the original hard copy submission.
- Form A-4, page 115.

Hard copies of pages 113-118, Forms A-3, A-4, and A-5 missing from the original hard copy submission will be provided in the revised submission document.

Revised Form A-4 received and reviewed by the Professional Team.

A-6 Deductibles and Policy Limits*

(*Significant Revision)

- A. The methods used in the development of mathematical distributions to reflect the effects of deductibles and policy limits shall be actuarially sound.**
- B. The relationship among the modeled deductible loss costs shall be reasonable.**
- C. Deductible loss costs shall be calculated in accordance with s. 627.701(5)(a), F.S.**

Audit

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

Pre-Visit Letter

28. A-6, Disclosure 3, page 96 – Provide a detailed description of the process used to ensure that deductibles are calculated in accordance with s. 627.701(5)(a), Florida Statutes.

Verified: YES

Professional Team Comments:

Discussed Doug Collins' review of the application of the annual deductible in the model.

Reviewed the process for how the annual deductible is calculated and applied.

Reviewed the code in the software where the annual deductible is applied.

Reviewed loss curves for each policy given a zero deductible, a hurricane deductible, and an all other perils deductible.

Reviewed the effect of the annual deductible on loss costs.

Reviewed the annual deductible component testing, review process, and verification of loss results.

Reviewed scatter plots of average annual loss for coverage A and coverage C, comparing the change from an occurrence deductible to an annual deductible.

Discussed how policy limits are handled.

A-7 Contents

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

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

Audit

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

Verified: YES

Professional Team Comments:

Discussed Doug Collins' review of contents loss costs, and verified no change in the methodology for handling contents losses.

A-8 Additional Living Expense (ALE)*

*(*Significant Revision)*

- A. The methods used in the development of Additional Living Expense (ALE) loss costs shall be actuarially sound.***
- B. ALE loss cost derivations shall consider the estimated time required to repair or replace the property.***
- C. The relationship between the modeled structure and ALE loss costs shall be reasonable, based on the relationship between historical structure and ALE losses.***
- D. ALE loss costs produced by the model shall appropriately consider ALE claims arising from damage to the infrastructure.***

Audit

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for ALE coverage. Documentation and justification of the following will be reviewed:
 - a. The method of derivation and data on which the ALE vulnerability function is based;
 - b. Validation data specifically applicable to ALE;
 - c. Assumptions regarding the coding of ALE losses by insurers;
 - d. The effects of demand surge on ALE for Hurricane Andrew;
 - e. Assumptions regarding the variability of ALE by size of property;
 - f. Statewide application of ALE assumptions;
 - g. Assumptions regarding ALE for mobile homes, tenants, and condo unit owners exposure;
 - h. The methods used to incorporate the estimated time required to repair or replace the property;
 - i. The methodology and available validation for determining the extent of infrastructure damage and its effect on ALE costs.
2. To the extent that historical data are used to develop mathematical depictions of ALE functions, demonstrate the goodness-of-fit of the data to fitted models.
3. Justify the differences in the relationship of structure and ALE loss costs from those previously found acceptable.

Verified: YES

Professional Team Comments:

Discussed Doug Collins' review of ALE loss costs, and verified no change in the methodology for handling ALE.

Discussed the development of ALE vulnerability considering damage to the infrastructure and demand surge, and validation of ALE losses regardless of whether there was damage to the building.

A-9 Output Ranges

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

B. All other factors held constant:

- 1. Output ranges produced by the model shall reflect lower loss costs for masonry construction versus frame construction.***
- 2. Output ranges produced by the model shall reflect lower loss costs for residential risk exposure versus mobile home risk exposure.***
- 3. Output ranges produced by the model shall reflect lower loss costs, in general, for inland counties versus coastal counties.***
- 4. Output ranges produced by the model shall reflect lower loss costs, in general, for northern counties versus southern counties.***

Audit

1. Forms A-7, A-8, and A-9 will be reviewed.
2. The modeler will be required to justify the following:
 - a. Changes from the prior submission of greater than five percent in weighted average loss costs for any county.
 - b. Changes from the prior submission of five percent or less in weighted average loss costs for any county.
3. Output Ranges will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.
4. Anomalies in the output range data will be reviewed and shall be justified.

Pre-Visit Letter

29. A-9, Disclosure 2, page 100 – Describe how each difference contributes to the percentages listed in Form A-8.
30. A-9, Disclosure 3, page 100 – Verify the percent changes in Statewide totals in Tables 4a to 4g. Page numbers are missing on these pages. Explain the multiple “#DIV/0!” entries. Also, review the nature of the counties experiencing increases.
32. Form A-7, page 122 – Provide detailed explanation for changes in Output Ranges for Clay County.

Verified: YES, ~~Contingent upon additional documentation provided to the Commission~~ Additional documentation received

Professional Team Comments:

Discussed Doug Collins’ review of the loss costs.

Reviewed changes in the Output Ranges for Clay, Duval, and Putman counties due to changes in the ZIP Code boundaries and changes in the terrain.

Discussed the impact of the changes in the model on the loss costs with the main effect being changes to the ZIP Code database.

Revised responses to be provided to the Commission:

- Pages 102-108, Tables 4a – 4g, revised to include page numbers.

Revised Tables 4a-4g received and reviewed by the Professional Team.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

- A. The use of historical data in developing the model shall be supported by rigorous methods published in currently accepted scientific literature.*
- B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods.*

Audit

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

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

Pre-Visit Letter

33. Form S-2, page 181 – Be prepared to discuss the change in Values of Part B.

Verified: YES

Professional Team Comments:

Reviewed results of statistical tests and graphical comparisons of modeled and historical frequency rates, tracks, intensity, and damage ratios in HURLOSS Risk Analysis Suite, Florida Hurricane Model, Validation Results, Statistical Tests, Verification, and Testing Results, Sensitivity and Uncertainty Binder, Volume I-B.

Reviewed results provided in Form S-2.

S-2 Sensitivity Analysis for Model Output

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

Audit

1. The modeler's sensitivity analysis will be reviewed in detail. Statistical techniques used to perform sensitivity analysis shall be explicitly stated. The results of the sensitivity analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.
2. Form S-5 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received

Professional Team Comments:

Reviewed sensitivity study results documented in HURLOSS Risk Analysis Suite, Florida Hurricane Model, Sensitivity and Uncertainty Studies, Volume I-D and determined that no new studies have been performed.

Revised response to be provided to the Commission:

- S-2.3, page 169, revised to correct Figure reference in last paragraph to Figure 31.

Revised response to S-2.3 received and reviewed by the Professional Team.

S-3 Uncertainty Analysis for Model Output

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

Audit

1. The modeler's uncertainty analysis will be reviewed in detail. Statistical techniques used to perform uncertainty analysis shall be explicitly stated. The results of the uncertainty analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.
2. Form S-5 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Reviewed uncertainty study results documented in HURLOSS Risk Analysis Suite, Florida Hurricane Model, Sensitivity and Uncertainty Studies, Volume I-D and determined that no new studies have been performed.

S-4 County Level Aggregation

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

Audit

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

Verified: YES

Professional Team Comments:

Verified no change in the process of sample size determination.

S-5 Replication of Known Hurricane Losses

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

Audit

1. The following information for each insurer and hurricane will be reviewed:
 - a. The validity of the model assessed by comparing expected losses produced by the model to actual observed losses incurred by insurers at both the state and county level,
 - b. The version of the model used to calculate modeled losses for each hurricane provided,
 - c. A general description of the data and its source,
 - d. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
 - e. The date of the exposures used for modeling and the date of the hurricane,
 - f. An explanation of differences in the actual and modeled hurricane parameters,
 - g. A listing of the departures, if any, in the wind field applied to a particular hurricane for the purpose of validation and the wind field used in the model under consideration,
 - h. The type of property used in each hurricane to address:
 - a. Personal versus commercial
 - b. Residential structures
 - c. Mobile homes
 - d. Condominiums
 - e. Structures only
 - f. Contents only,
 - i. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.
2. The following documentation will be reviewed:
 - a. Publicly available documentation referenced in the submission,
 - b. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
 - c. An analysis that identifies and explains anomalies observed in the validation data,

- d. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.
3. The confidence intervals used to gauge the comparison between historical and modeled losses will be reviewed.
4. Form S-3 will be reviewed.
5. The results of one hurricane event for more than one insurance company and the results from one insurance company for more than one hurricane event will be reviewed to the extent data are available.

Verified: YES

Professional Team Comments:

Reviewed validation comparisons provided in Form S-3 and verified no changes.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-4 will be reviewed.
2. Justify the following:
 - a. Meteorological parameters,
 - b. The effect of by-passing storms,
 - c. The effect of actual hurricanes that had two landfalls impacting Florida,
 - d. The departures, if any, from the wind field, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration, and
 - e. Exposure assumptions.

Verified: YES, Contingent upon additional documentation provided to the Commission Additional documentation received

Professional Team Comments:

Reviewed results provided in Form S-4.

Revised response to be provided to the Commission:

- S-6.1, page 179, Figure 37 to be corrected.

Revised response to S-6.1, Figure 37 received and reviewed by the Professional Team.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

A. The modeler shall maintain a primary document binder, containing a complete set of documents specifying the model structure, detailed software description, and functionality. Development of each section shall be indicative of accepted software engineering practices.

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

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

Audit

1. The primary document binder, in either electronic or physical form, and its maintenance process will be reviewed. The binder shall contain fully documented sections for each Computer Standard.
2. All documentation shall be easily accessible from a central location.
3. Complete user documentation, including all recent updates, will be reviewed.
4. Modeler personnel, or their designated proxies, responsible for each aspect of the software (i.e. user interface, quality assurance, engineering, actuarial) shall be present when the Computer Standards are being audited. Internal users of the software will be interviewed.
5. Provide verification that documentation is created separately from the source code.

Verified: YES

Professional Team Comments:

Reviewed the HURLOSS Risk Analysis Suite, Primary Documents Binder, Volume 0-A containing documentation on requirements, component design, implementation, verification, maintenance and revision, security, and user documentation.

C-2 Requirements

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the requirements specifications and design for application of the annual deductible in the model.

Reviewed the requirements specifications documented for the hurricane simulation model, the building damage and loss model, and the portfolio analysis model.

- HURLOSS Risk Analysis Suite, LIFESIM-I: Hurricane Model, Volume I-A.
- HURLOSS Risk Analysis Suite, HURLOSS Portfolio Analysis Application, Volume III-D.
- HURLOSS Risk Analysis Suite, Individual Ground-Up Building Loss, Volume II-E
- HURLOSS Risk Analysis Suite, Individual Building Damage Model, Volume II-B

C-3 Model Architecture and Component Design

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the flow chart for the update to the computer code for application of the annual deductible.

Reviewed the interface diagrams and component design documents for the three model groups – hurricane simulation, building damage and loss, and portfolio analysis.

Reviewed control and dataflow diagrams for LIFESIM-I, HURLOSS, and HURR-80.

Reviewed HURLOSS Data Import flow diagram.

C-4 Implementation

- A. The modeler shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.***
- B. The modeler shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.***
- C. All components shall be traceable, through explicit component identification in the flow diagrams, down to the code level.***
- D. The modeler shall maintain a table of all software components affecting loss costs, with the following table columns: (1) Component name, (2) Number of lines of code, minus blank and comment lines; and (3) Number of explanatory comment lines.***
- E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.***

Audit

1. The interfaces and the coupling assumptions will be reviewed.
2. Provide the documented coding guidelines and confirm that these guidelines are uniformly implemented.
3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.
4. The traceability among components at all levels of representation will be reviewed.
5. The following information shall be available and will be reviewed for each component, either in a header comment block, source control database, or the documentation: component name, date created, dates modified and by whom, purpose or function of the component, and input and output parameter definitions.
6. The table of all software components as specified in C-4.D will be reviewed.
7. Model components and the method of mapping to elements in the computer program will be reviewed.
8. Comments within components will be examined for sufficiency, consistency, and explanatory quality.

Verified: YES

Professional Team Comments:

Reviewed Code Statistics for all the HURLOSS Suite of Models including number of files, lines of code, lines of code with trailing comments, explanatory comment lines, other comment lines, blank lines, and total.

Reviewed the coding guidelines for C++ and Fortran documentation contained in HURLOSS Risk Analysis Suite, Primary Documents Binder, Volume 0-A.

Reviewed the model components and the method of mapping to elements contained in HURLOSS Risk Analysis Suite, LIFESIM-I: Hurricane Model, Volume I-A.

Reviewed the revised event definition implementation regarding Standard M-3, Disclosures 1 and 2.

Reviewed roughness level interpolation code.

Reviewed the filling rate calculation for different geographic regions and their boundaries.

Reviewed the code containing the minimum wind speed at which damage occurs.

Reviewed the code for the derivation and updating of the vulnerability functions.

Reviewed multiple deductible code relative to Standard A-6.

C-5 Verification

A. General

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

B. Component Testing

- 1. The modeler shall use testing software to assist in documenting and analyzing all components.*
- 2. Unit tests shall be performed and documented for each component.*
- 3. Regression tests shall be performed and documented on incremental builds.*
- 4. Aggregation tests shall be performed and documented to ensure the correctness of all model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.*

C. Data Testing

- 1. The modeler shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.*
- 2. The modeler shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.*

Audit

- 1. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.*
- 2. The testing software used by the modeler will be reviewed.*
- 3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed.*

Pre-Visit Letter

34. C-5.B-4, pages 192-193 – Demonstrate that sufficient testing has been performed to ensure that all components have been executed at least once.

Verified: YES

Professional Team Comments:

Reviewed process and documentation for software verification and validation.

Discussed the testing performed to ensure all components have been executed at least once.

Reviewed the computer code and procedures for unit testing.

Discussed the component and data test processes and their documentation.

C-6 Model Maintenance and Revision

- A. The modeler shall maintain a clearly written policy for model revision, including verification and validation of revised components, databases, and data files.***
- B. A revision to any portion of the model that results in a change in any Florida residential hurricane loss cost shall result in a new model version number.***
- C. The modeler shall use tracking software to identify all errors, as well as modifications to code, data, and documentation.***

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the policy for model revisions contained in HURLOSS Risk Analysis Suite, Primary Document Binder, Volume 0-A.

Reviewed the software maintenance and revision documentation for changes made in the model.

C-7 Security

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

Audit

1. The written policy for all procedures and methods used to ensure the security of code, data, and documentation will be reviewed. Specify all security procedures.
2. Documented security procedures for access, client model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the security policies and procedures for ARA and the HURLOSS suite of programs contained in HURLOSS Risk Analysis Suite, Primary Document Binder, Volume 0-A.

Discussed procedures in place to ensure against code losses in the event of a catastrophe.