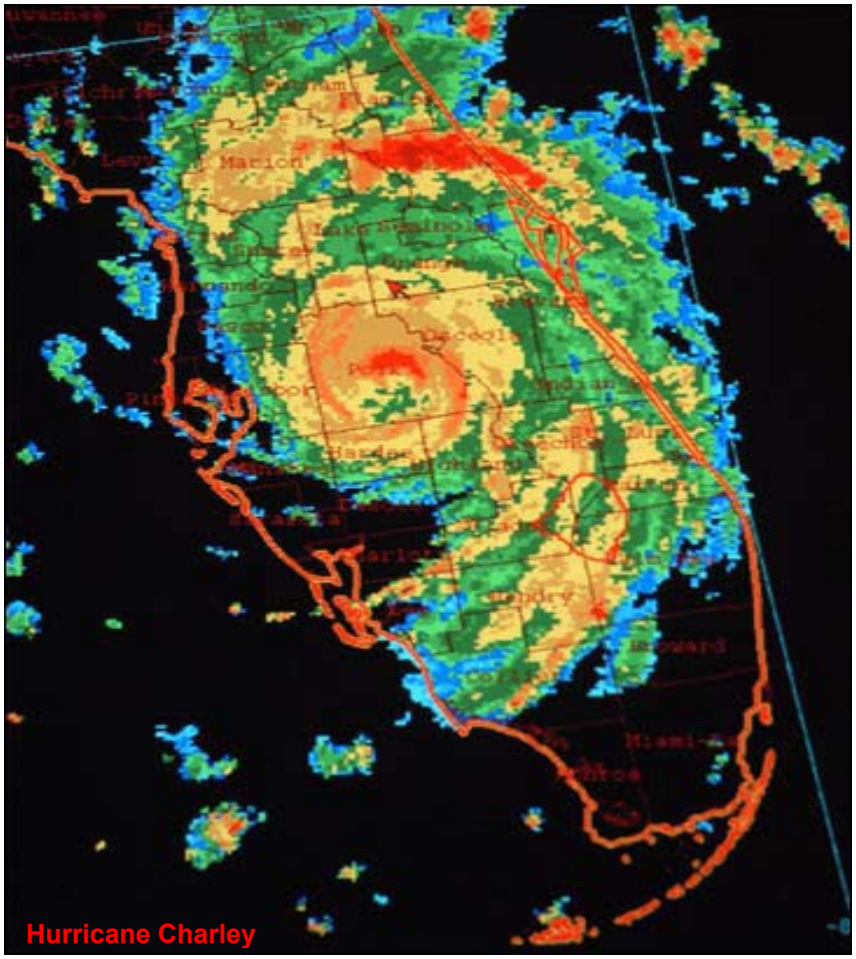
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2004 Standards

Applied Research Associates, Inc.

On-Site Review
April 18 & 19, 2005

On April 18&19, 2005, the Professional Team visited on-site at Applied Research Associates, Inc. (ARA) in Raleigh, North Carolina. The following individuals participated in the review.

ARA

Yingzhao (Justin) Chen, Staff Scientist
Chris Driscoll, Staff Scientist
Brian Grant, M.S., Software Developer, Southeast Division
Reddy S. Kadasani, M.S., Senior Computer Scientist
Francis M. Lavelle, Ph.D., P.E., Principal Engineer
Jeffrey C. Sciaudone, Senior Scientist
Rick Pearson, Software Developer
Peter J. Vickery, Ph.D., P.E., Principal Engineer
Dhiraj Wadhera, Staff Scientist

Professional Team

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

The review began with introductions and an overview of the audit process. ARA explained the model changes since the February 2004 submission:

- Update through the 2004 season the starting locations from the observed storms
- Update of the filling model

Discussed and reviewed corrections to be made in the submission that will be provided to the Commission prior to the June 1-3, 2005 meetings.

- Page 19, Vickery and Skerlj, references to *Hurricane Gust Factors Revisited*, date updated to 2005.
- Page 20, G-1.2, response revised to be consistent with Disclosure C-4.1.
- Page 31, G-2.3.B, reference to Appendix C, Computer Science Review added.
- Pages 38-43, Forms G-1 through G-6 with updated signatures after revisions made to the original February 28, 2005 submission.
- Page 48, M-2.5, Vickery et al. reference date updated to indicate which 2000 paper.
- Page 71, V-1.C, response revised to include gable end bracing being treated as a modification to the vulnerability functions.
- Page 85, A-2.4, response revised to remove statement of assumptions being provided to the Professional Team.
- Page 85, A-2.5, response revised to indicate the approach used is reasonable.
- Page 166, S-1.2, response revised to update years used for frequency distributions and correct Ho reference date to 1987.
- Page 167, S-1.3, Vickery et al. reference date updated to indicate which 2000 paper.

- Page 167, S-1.5, response revised to reflect correct percentages.
- Page 169, S-2.3, response revised to reflect correct percentages.
- Page 172, S-3.3, response revised to correct figure reference to Figure 29.

All of the above revisions are included in the revised submission received on 5/27/05.

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the March 10 & 11, 2005 meetings. All deficiencies were corrected by the established time frame and have been verified. A copy of the revised submission pages, with the revisions made to the original submission highlighted, is enclosed with this report.

1. Response to standards. The Report of Activities (page 33) states, "If a Standard or Disclosure has multiple sections, respond to each separately." The following list of standards indicates standards for which responses are not given separately: G-2, G-3, G-4, M-4, M-5, M-6, V-2, A-1, A-2, A-7, A-8, A-9, S-1, C-1, C-4, C-5 and C-6. Additionally, the Forms M-1, M-3 B and V-2 have blanket responses. Although at times it might be apparent as to the modeler's intentions (e.g., A-6), on others no response is given.

   Revised pages submitted:
   - Page 22, separate responses provided in support of compliance with each section of Standard G-2.
   - Page 33, separate responses provided in support of compliance with each section of Standard G-3
   - Page 34, separate responses provided in support of compliance with each section of Standard G-4.
   - Page 56, separate responses provided in support of compliance with each section of Standard M-4.
   - Page 58, separate responses provided in support of compliance with each section of Standard M-5.
   - Page 61, separate responses provided in support of compliance with each section of Standard M-6.
   - Page 62, separate responses provided for each section of Form M-1.
   - Page 68, separate response provided for section B of Form M-3.
   - Page 76, separate responses provided in support of compliance with each section of Standard V-2.
   - Page 81, separate responses provided for each section of Form V-2.
   - Page 83, response provided in support of compliance with Standard A-1.
   - Page 84, separate responses provided in support of compliance with each section of Standard A-2.
   - Page 95, separate responses provided in support of compliance with each section of Standard A-6.
   - Page 96, separate responses provided in support of compliance with each section of Standard A-7.
   - Page 97, separate responses provided in support of compliance with each section of Standard A-8.
   - Page 99, separate responses provided in support of compliance with each section of Standard A-9.
   - Page 165, separate responses provided in support of compliance with each section of Standard S-1.
   - Page 189, separate responses provided in support of compliance with each section of Standard C-1.
   - Page 192, separate responses provided in support of compliance with each section of Standard C-4.

- Pages 194-195, separate responses provided in support of compliance with each section of Standard C-5.
- Page 196, separate responses provided in support of compliance with each section of Standard C-6.

2. References. There are places in the submission in which cited material is incomplete (e.g., publication dates). For example:

   M-2. Disclosure 9. Page 53. Vickery and Skerlj reference date. Since it has appeared now, it needs to be provided as part of the submission.
   Page 51. Powell et al. (2003), page numbers needed.
   Page 53. Vickery (2000b), page numbers needed.

   Revised pages 51, 53, and 209-210 submitted with specified references completed. Proof copies of the Vickery and Skerlj paper were also provided.

3. List of Figures, Figure 17. Page 13. Mentions old Forms S-1A and S-1B.

   Revised page 13 submitted with corrected figure title.

4. Checklist, Item 3. Page 9. The material to be presented should be listed (even if it is similar to last year).

   Page 9 submitted with revised response and items to be presented listed.

5. G-2. Disclosure 2.A, Table 1. Page 25. Provide credentials for Steve Businger and Brian Grant.

   Revised page 25 submitted with credentials added for Businger, Grant, and Collins.

6. G-2. Disclosure 3.A. Page 31. Provide the dates of the peer reviews.

   Revised page 31 submitted with the dates of the peer reviews provided.

7. M-2. Disclosure 4. Page 48. Identify the average time.

   Revised page 48 submitted with the averaging times provided.

8. M-3. Disclosure 3. Page 55. Provide maximum wind for Category 5 hurricanes.

   Revised page 55 submitted with the maximum simulated wind speed for Category 5 hurricanes provided.

9. M-5. Disclosure 2. Page 59. Identify the variables related to “etc.”

   Revised page 59 submitted with additional variables identified.

10. M-5. Disclosure 3. Page 59. Justify the timeliness of these data bases for Florida.

Revised page 60 submitted with justification for the timeliness of the LULC data bases provided.

11. Form M-3.B. Page 68. Response to this item is not given.

    Revised page 68 submitted with a response to item B provided.

12. Form V-2. Page 82. The no skylight and no door covers cases were separated into two cases, which is not what was requested.

    Revised page 82 submitted with corrections to Form V-2 provided.

13. A-6. Disclosure 2. Page 95. Non-responsive to second sentence of disclosure.

    Revised page 95 submitted with response provided for second sentence of Disclosure 2.

14. A-9. Disclosure 3. Tables 4f and 4g. Pages 106-107. Explain entries that indicate division by zero.

    Revised page 100 submitted providing explanation for entries indicating division by zero.

15. Form A-6.D. Page 118. Graphical comparison is not given.

    Revised page 119 submitted with graph provided.

16. Form A-9. Page 163. Labels within counties are illegible.

    Revised page 163 submitted.

17. S-4. Page 173. Labels within counties are illegible.

    Revised page 173 submitted.

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.

3. Databases or data files relevant to the modeler's submission will be reviewed.

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

Professional Team Comments:

Reviewed detailed flow chart of the new filling model component.

Revised page 19 with references to Vickery and Skerlj paper, *Hurricane Gust Factors Revisited*, updated for correct reference date to be provided to the Commission.

Response to Disclosure G-1.2 revised to be consistent with Disclosure C-4.1 to be provided to the Commission.

Revised response to G-1.2, pages 19 & 20 received and reviewed by the Professional Team.

G-2 Qualifications of Modeler Personnel and Independent Experts

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

B. The model or any modifications to an accepted model shall be reviewed by either modeler personnel or independent experts 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 independent experts 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 incidents where modeler personnel have been found to have failed to abide by the standards of professional conduct adopted by their profession.

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

Professional Team Comments:

Interviewed Brian Grant regarding Form G-6.

Revised response to Disclosure G-2.3.B to include reference to Appendix C, Computer Science Review to be provided to the Commission.

Revised response to G-2.3.B, page 31 received and reviewed by the Professional Team.

Revised Forms G-1 through G-6 with updated signatures after revisions to the original submission are complete to be provided to the Commission.

Revised Forms G-1 through G-6, pages 38-43 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.

Verified: YES

Professional Team Comments:

Reviewed ZIP Code boundary maps showing boundaries, centroids, and roughness.

G-4 Units of Measurement

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

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

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

Audit

The appropriateness and accuracy of the measurements, conversion factors, and techniques will be reviewed.

Pre-Visit Letter

1. G-4.1, page 34 and M-2.3, page 48 – How were the measured wind data adjusted to 10m equivalent? How were measured winds adjusted to a common averaging time for validation of modeled wind values?

Verified: **YES**

Professional Team Comments:

Appropriate units of measurement were verified throughout the review process.

Reviewed the process for adjusting wind speeds for validation. Discussed Vickery and Skerlj (2005) paper.

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.

Pre-Visit Letter

2. G-5, page 35 – Be prepared to show documentation supporting independent wind speed and damage model and loss model verification.

Verified: YES

Professional Team Comments:

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

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Official Hurricane Set*

*(*Significant Revision)*

For landfall frequency analyses, the modeler shall use the latest updated Official Hurricane Set. Updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to the Official Hurricane Set. Additional information from the National Hurricane Center or from peer reviewed atmospheric science literature can be used to justify modifications to the Official Hurricane Set.

Audit

1. The modeler will provide the hurricane set used. Failure to update the hurricane set to the most recent year is not acceptable. For revisions to HURDAT, only complete incremental revisions are acceptable.

2. The additional information from the National Hurricane Center or from peer reviewed atmospheric science literature will be reviewed.

Verified: YES

Professional Team Comments:

Verified that for verification of landfall frequencies the stochastic storm set includes all storms in HURDAT and the 2004 storms from the National Hurricane Center. For development of storm characteristics, HURDAT information back to 1886 is added.

Reviewed binders containing historical storm database.

M-2 Hurricane Characteristics*

*(*Significant Revision)*

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

Audit

1. Identify all of the hurricane characteristics used in the model. For hurricane characteristics modeled as random variables describe the probability distributions used.

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.

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

7. All modeler-specific scientific literature provided in Disclosure 9 will be reviewed to determine acceptability.

Pre-Visit Letter

3. M-2, page 46, paragraph 3 – "The central pressure is modeled through the use of a relative intensity parameter, which is coupled to the sea surface temperature". How are sea surface temperature changes in the course of the hurricane season treated? Are the related variables treated as constants in the estimation of output ranges?

4. M-2, Equation (3), page 47 – Be prepared to discuss the updates.

5. M-2.4, page 48 – Identify the averaging time for gusts. If no uniform gust averaging time is assumed, explain how use of the turbulence models referenced provides appropriate winds for use in the vulnerability model.

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

Professional Team Comments:

Reviewed the process for incorporating sea surface temperature into the model. Reviewed values for constants used in the central pressure model. Reviewed data sources and averaging times used to set reference meteorological variables.

Reviewed the conversion to gust wind speed in the model and the gust factor curve based on the duration of the mean winds.

Verified that Equation (3), page 47, is the same representation of Rmax as in last year's submission but is an update on the Vickery et al. (2000b) journal article.

Reviewed treatment of inherent uncertainties in gradient to surface wind conversion. Ascertained that a spatial variation of this conversion is implemented in the model.

Modeler expressed doubts relative to the quality of the available historical data on radius to hurricane force winds.

Modeler-specific scientific literature was reviewed and discussed in detail.

Reviewed the effects of surface roughness on surface wind speeds over water, land, and the transition between these. Verified gust factors used in these regions.

Response to Disclosure M-2.5, page 48, revised to indicate which 2000 Vickery paper is referenced to be provided to the Commission.

Revised response to M-2.5, page 48 received and reviewed by the Professional Team.

M-3 Landfall Intensity*

*(*Significant Revision)*

Models shall use maximum one-minute sustained 10-meter wind speed when defining hurricane landfall intensity. This applies both to the Official Hurricane 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

6. M-3.1, page 54 – We would like to review the implementation of the event definition. In particular, how is the maximum wind speed over land determined in the code?

Verified: YES

Professional Team Comments:

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

Reviewed the effects on the average annual loss cost of changing the wind speed threshold for the definition of an event. Determined that this effect was negligible for reasonable values of the wind speed threshold.

Reviewed computer code in which this criterion is applied to storms from the stochastic storm set.

M-4 Hurricane Probabilities*

*(*Significant Revision)*

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

B. Modeled hurricane probabilities shall reasonably reflect the Official Hurricane Set through 2003 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. 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 and landfall angles.

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

6. Provide the source documents or any research performed to develop the functions used for simulating model variables or databases.

Pre-Visit Letter

7. M-4, page 56, paragraph 2 – We would like to review the update on statistical models for radii to maximum winds, etc.

10. Form M-1, page 64 – Explain the differences in the historical probabilities from those provided by the Commission.

Verified: YES

Professional Team Comments:

Reviewed the statistical models for Rmax.

Ascertained that the historical frequencies provided in Form M-1 include the 2004 storms – Charley, Frances, Jeanne, and Ivan (by-pass).

M-5 Land Friction and Weakening

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 historical Florida hurricanes and to weakening rates 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

8. M-5.1, page 58 – The decay rates have been updated. Provide the material supporting the updates.

9. M-5.2, page 59 – How does air-sea temperature difference play a role here?

Verified: YES

Professional Team Comments:

Reviewed in detail the changes to the over-land filling model. Reviewed the storm parameters used in developing, analyzing and determining the changes made to the filling rate model. Reviewed comparison of historical events with new filling treatment. Reviewed effects of treatment to stochastic storm events.

Reviewed modeler specific filling rate model documentation.

Reviewed the variable effect of air-sea temperature on surface wind speed estimates.

Reviewed implementation of new filling rate model in the code.

Reviewed timeliness of land use land cover database.

Reviewed results provided in Form M-2. As requested in Form M-2, Figure 11 does not include 2004 storms.

M-6 Logical Relationships of Hurricane Characteristics*

*(*Significant Revision due to Form M-3)*

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

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

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed Form M-3 table and Figure 13 and the treatment of Rmax in the model.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision due to Form V-1)*

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

11. V-1, page 71 – Be prepared to discuss and show documents indicating how the vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense are derived.

12. V-1.2, page 73 – Be prepared to discuss the nature and extent of the actual insurance claims data used in the vulnerability model

13. V-1.5, page 74 – Specifically describe the structure types, lines of business, and coverages in which a unique vulnerability function is used.

14. Form V-1, page 78 – Be prepared to discuss the significant change in the Part B estimated damages from the 2003 submission numbers.

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

Professional Team Comments:

Reviewed the regional distribution of construction types.

Reviewed examples of vulnerability curves in terms of peak gust wind speed for different structure types, contents, and ALE loss.

Reviewed the damage modeling flow chart and the process for development of building vulnerability functions.

Reviewed vulnerability curves for various deductibles.

Reviewed the results in Form V-1 for wood/frame, masonry, and mobile home and changes in the estimated damages from the 2003 submission.

Reviewed how code enforcement is considered in the development and application of the vulnerability functions.

Reviewed loss functions used for completion of Form V-1.

Reviewed HURLOSS Risk Analysis Suite, Historical Storm Validation, Volume III-E.

Revised response to V-1.C to be provided to the Commission.

Revised response to V-1.C, page 71 received and reviewed by the Professional Team.

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

15. Form V-2, page 82 – For the mitigated structure cell at the bottom of Form V-2 (structure), define which type of shutters are used.

Verified: YES

Professional Team Comments:

Reviewed in detail the results for the various mitigation factors provided in Form V-2.

Reviewed mitigated structure characteristics including shutters.

Reviewed impact of multiple mitigations versus individual mitigation.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs*

*(*New Standard)*

Modeled loss costs shall reflect all damages starting when damage is first caused in Florida from an event modeled as a hurricane at that point in time and will include all subsequent damage in Florida from that event.

Any variations in modeled loss costs shall be justified.

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

16. A-1, page 83 – Be prepared to describe how ARA estimates damage from bypassing storms. Include in the description, examples of storms that reach hurricane strength prior to or subsequent to causing damage in Florida and are not of hurricane strength when damage is

caused in Florida. This was a general issue broached at the March 10-11 Commission meeting.

17. A-1.2, page 83 – Describe how bypassing storms impact on loss costs if the peak gusts exceed 80 mph on land in a neighboring state but do not reach 80 mph on land in Florida.

18. A-1.3, page 83 – Describe the relationship between the 80 mph peak gusts referenced in paragraph 2 with the 50 mph peak gusts referenced in paragraph 3.

Verified: YES

Professional Team Comments:

Reviewed the definition of an event in the model, the handling of several different bypassing storms, and the handling of multiple events at a single location.

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.

Pre-Visit Letter

19. A-2, page 84 – Provide any insurance data obtained since the prior review of the model by the FCHLPM.

20. A-2.2, page 84 – Describe the methods used to apply the information for "construction types that are prevalent in a given region" with construction types used by the insurance industry in their rate filings.

21. A-2.4, page 85 – Present the information cited to be "provided to the professional team".

22. A-2.5, page 85 – Provide the insurance data used to validate the model as referenced in this section. Describe how this insurance data "indicates that this assumption is valid".

23. A-2.6, page 85 – Provide details of the material and analyses used to reach the conclusions referenced in this section.

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

Professional Team Comments:

Reviewed the consideration of claims payment practices and verified no changes are made to the data based upon company claims payment practices.

Reviewed the methods employed relative to the use of insurance data.

Reviewed claims data contained in HURLOSS Risk Analysis Suite, Historical Storm Validation, Volume III-E.

Revised response to Disclosures A-2.4 and A-2.5 to be provided to the Commission.

Revised responses to A-2.4 and A-2.5, page 85 received and reviewed by the Professional Team.

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.

Pre-Visit Letter

24. A-3.2, page 86 – Describe the analyses performed to validate the model output loss costs using insurance company data that may or may not include the effects of demand surge.

Verified: YES

Professional Team Comments:

Reviewed how demand surge is handled and verified that it was not explicitly used in preparation of the loss cost projections.

Verified through reviewing the model 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

25. A-4, page 88, paragraph, under "Assumptions/Defaults." – Present the information cited "to be shown to the professional team".

26. A-4.2, page 88 – Present the information cited "will be made available to the professional team"

Verified: YES

Professional Team Comments:

Reviewed the HURLOSS User Manual that documents the model input requirements.

Reviewed the assumptions and default settings for the building stock distribution.

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, 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. Form A-4, page 114 – Be prepared to discuss changes in this form from last year.

32. Form A-5, page 115 – Be prepared to discuss changes in this form from last year. Aside from changes from last year, the ZIP Codes included will be discussed. Was a minimum threshold of damages set?

33. Form A-5, page 117 – Explain the 0% of losses ZIPs. What is the exposure in those ZIP Codes?

34. Form A-6, page 118 – Be prepared to discuss changes in this form from last year.

Verified: YES

Professional Team Comments:

Reviewed the differences given on Form A-3, zero deductible loss costs by ZIP Code in Figures 20, 21 and 22.

Reviewed Forms A-4, A-5, and A-6 versus last year's counterparts and the reasons for differences, if any.

A-6 Deductibles and Policy Limits

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

B. The relationship among the modeled deductible loss costs shall be reasonable.

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

27. A-6, page 95 – Present the information cited "will be presented to the professional team".

28. A-6, page 95 – Whether 2004 insurer claim experience is incorporated in the development, testing or verification of the current model version or not, describe the methods used to account for the implementation of multiple deductibles in the insurers' claim payment historical records for policy periods where more than one hurricane caused damage at a single location. Describe how multiple deductible claim experience in the historical record is included in the projection of future loss costs. Describe any differences between the process used to account for "multiple deductibles" in this submission and the process used in prior submissions.

Verified: YES

Professional Team Comments:

Reviewed the handling of deductibles in the model.

Verified no change in the methodology for handling deductibles and policy limits.

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 impact of multiple storms over same location on claims data.

Verified no change in the methodology for handling contents losses.

A-8 Additional Living Expense (ALE)

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

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

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

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:

Verified no changes were made to the methodology for handling ALE.

Reviewed specifics regarding development and validation of ALE vulnerability functions.

A-9 Output Ranges*

*(*Significant Revision)*

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

B. All other factors held constant:

1. ***Output ranges produced by the model shall have a pattern of declining loss costs with increasing deductibles.***
2. ***Output ranges produced by the model shall reflect lower loss costs for masonry construction versus frame construction.***
3. ***Output ranges produced by the model shall reflect lower loss costs for residential risk exposure versus mobile home risk exposure.***
4. ***Output ranges produced by the model shall reflect lower loss costs, in general, for inland counties versus coastal counties.***
5. ***Output ranges produced by the model shall reflect lower loss costs, in general, for northern counties versus southern counties.***
6. ***Output ranges produced by the model shall reflect lower loss costs for contents versus structures.***
7. ***Output ranges produced by the model shall reflect lower loss costs for additional living expense versus structures.***
8. ***Output ranges produced by the model shall be positive and non-zero for all given risk exposures.***

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

Be prepared to explain in detail the new hurricane filling model. There are some large changes in output ranges, page 163. However, the changes in Form S-4, page 186, are modest. Be prepared to explain this.

29. A-9, page 100 – Describe the separate contribution to the differences in output ranges from the prior submission separately relative to:
    1. two more years of storm data
    2. new filling model
    3. any other criteria causing change

    We would like to see more details on Levy County.

30. Table 4a-4g, pages 101 through 107. Be prepared to provide descriptions of the underlying cause for each output range value that exhibited a change of 10% or more from those in the prior submission. In particular, why are the contributions the same for individual storms in light of model changes?

Verified: YES

Professional Team Comments:

Reviewed the changes to the average annual loss cost by county for:

- Adding the 2003 hurricane season
- Adding the 2004 hurricane season
- Implementing the new filling model
- Combined effect of all changes

Reviewed the methodology for updating the model after each hurricane season.

Reviewed the results for Levy County and the driving factors for the loss cost changes.

Reviewed current treatment of deductibles for multiple storms in a season.

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

35. S-1, page 165 – What far field pressure is used for the deficit calculation?

36. S-1.5, page 167 – Provide supporting material for the reported 95% confidence interval.

37. Form S-2, page 182 – Be prepared to discuss the changes in this form from last year, in particular, the large increases for longer return times.

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

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-1 and verified the inclusion of the 2004 season.

Reviewed the changes in Form S-2 from last year and the increases for longer return times.

Reviewed the meteorology goodness-of-fit and validation tests performed for the new filling model documented in modeler-specific literature, submitted for publication to Journal of Applied Meteorology.

Response to Disclosure S-1.2 revised to update years used for frequency distributions and correct Ho reference date to 1987 to be provided to the Commission.

Revised response to S-1.2, page 166 received and reviewed by the Professional Team.

Response to Disclosure S-1.3 revised to indicate which 2000 Vickery paper is referenced to be provided to the Commission.

Revised response to S-1.3, page 167 received and reviewed by the Professional Team.

Response to Disclosure S-1.5 revised to reflect correct percentages to be provided to the Commission.

Revised response to S-1.5, page 167 received and reviewed by the Professional Team.

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

Response to Disclosure S-2.3 revised to reflect correct percentages to be provided to the Commission.

Revised response to S-2.3, page 169 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, ~~Contingent upon additional documentation provided to the Commission~~ Additional documentation received**

Professional Team Comments:

Reviewed uncertainty study results documented in HURLOSS Risk Analysis Suite, Florida Hurricane Model, Sensitivity and Uncertainty Studies, Volume I-D.

Response to Disclosure S-3.3 revised to correct figure reference to Figure 29 to be provided to the Commission.

Revised response to S-3.3, page 172 received and reviewed by the Professional Team.

S-4 County Level Aggregation*

(Significant Revision due to possible change in loss costs)*

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:

Reviewed the process and results of the sampling of the stochastic storm set using 300,000 years under various scenarios (storm sets and filling rate model).

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 results for validating damage estimation documentation:

- HurLoss Risk Analysis Suite, Individual Building Damage Model, Part I, Volume II-B
- HurLoss Risk Analysis Suite, Florida Hurricane Model, Validation Results, Statistical Tests, Verification, and Testing Results, Volume I-B.

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.

Pre-Visit Letter

Be prepared to explain in detail the new hurricane filling model. There are some large changes in output ranges, page 163. However, the changes in Form S-4, page 186, are modest. Be prepared to explain this.

Verified: YES

Professional Team Comments:

Reviewed Form S-4 and the revised response provided for the 95% confidence interval on the differences between the means of the historical and modeled loss.

Reviewed the differences in the changes provided in Form S-4 compared to the changes provided in the Output Ranges.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation*

*(*Significant Revision)*

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.

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*

*(*Significant Revision)*

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 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 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 LIFESIM-I flowchart for the new filling rate model calculations.

Reviewed HURLOSS Data Import flow diagram.

C-4 Implementation*

*(*Significant Revision)*

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 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 and consistency.

Verified: YES

Professional Team Comments:

Reviewed code for new filling rate model component and the incorporated explanatory comments.

Reviewed code metrics table for the HURLOSS suite of models including the hurricane simulation model, the building damage and loss model, and the portfolio analysis model by group of components.

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

Reviewed component comments in the hurricane simulation subroutines for selecting storms with peak gust winds exceeding 80 mph, loss events, and swath conversions.

Reviewed the validation procedure for the external datasets for open terrain used in the new filling model. Reviewed the requirements, flow chart, validation test results documented in HURLOSS Risk Analysis Suite, Terrain Database, Volume III-B.

C-5 Verification*

*(*Significant Revision)*

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 components, defining the model.***

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

38. C-5, pages 194-195 – Be prepared to show detailed unit test documentation for testing on each model component, including all aspects of the model (meteorology, actuarial, vulnerability, statistics, user interface, and other components).

Verified: YES

Professional Team Comments:

Reviewed unit testing for the new filling rate model. Reviewed plot comparisons of the old filling rate versus new filling rate model.

Reviewed testing method relating to land use and land cover data.

Reviewed test for correct bounds on a variable within the filling rate model, and a flag-triggered output verification.

Reviewed example of regression testing including the test cases considered for percentage changes in output ranges.

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 between incremental versions of the hurricane simulation model, the building damage and loss model, and the portfolio analysis model.

C-7 Security*

*(*Significant Revision)*

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 Documents Binder, Volume 0-A.