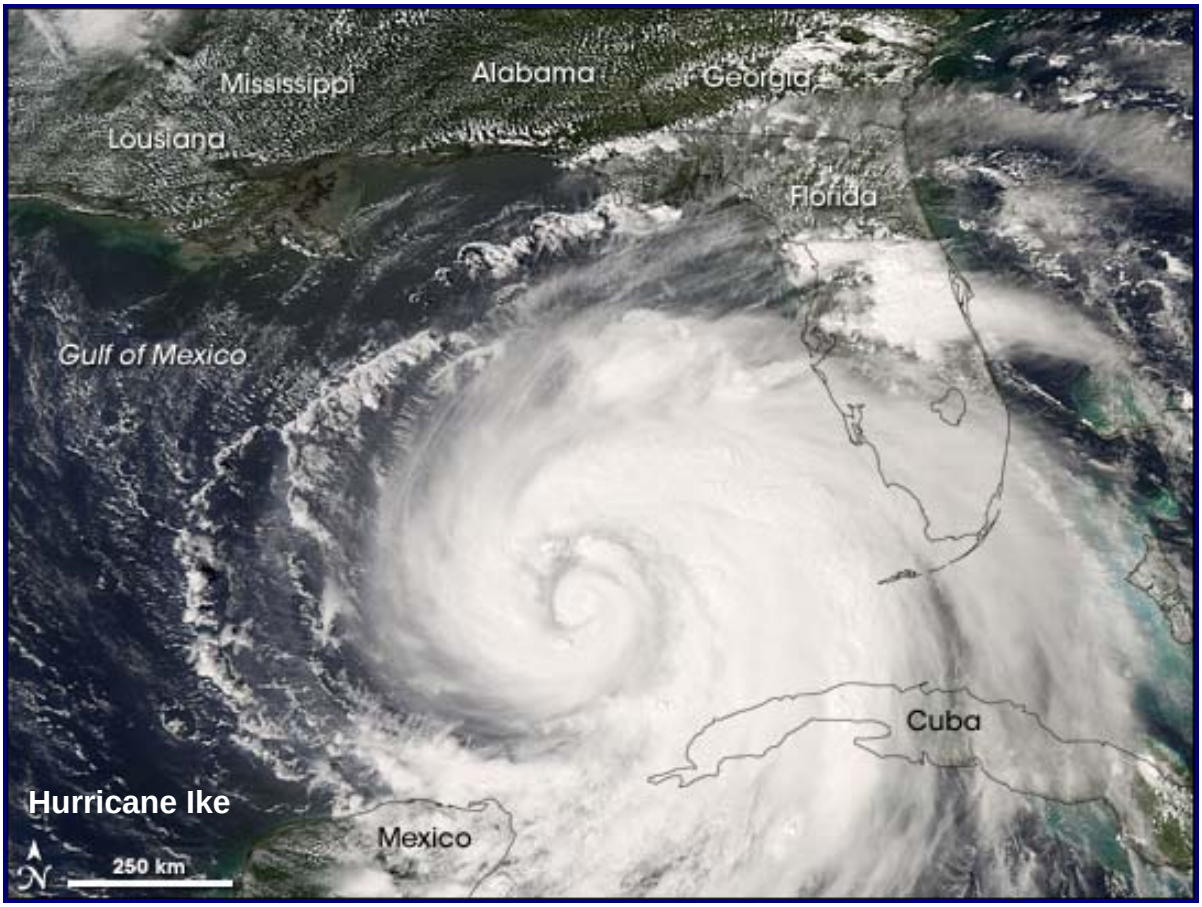
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2008 Standards

Applied Research Associates, Inc.

On-Site Review
April 8 – 10, 2009

Additional Verification Review
June 1, 2009

On April 8-10, 2009 the Professional Team visited on-site at Applied Research Associates, Inc. (ARA) in Raleigh, North Carolina. The following individuals participated in the review:

ARA

Justin Chen, Ph.D., Staff Scientist
Douglas Collins, Actuarial Consultant (via phone)
Marshall B. Hardy, Staff Scientist
Francis M. Lavelle, Ph.D., P.E., Principal Engineer
Janet MacKenzie, Senior Technical Editor
Jeffrey C. Sciaudone, P.E., Senior Scientist
Peter J. Vickery, Ph.D., P.E., Principal Engineer
Dhiraj Wadhera, Staff Scientist

Professional Team

Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
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 provided a detailed, proprietary presentation of the changes made in the 2009 model (HurLoss 4.2a):

- Updated to include data from the 2007 hurricane season
- Updated the surface roughness model based on Florida land use and land cover data produced by the Multi-Resolution Land Use Consortium on 4/25/2007
- Updated the residential vulnerability functions
- Updated the building stock distributions used to weight and combine the residential vulnerability functions
- Implemented changes to building stock for attached and detached exterior structures

The predominantly proprietary aspects of the changes were new to the Professional Team. Several binders containing further documentation were available and reviewed concurrently with the presentation. Details of the review are sketched in the relevant standard sections given subsequently.

The Professional Team reviewed ARA's responses to the deficiencies and issues noted at the March 19, 2009, Commission meeting. ARA provided updated Expert Certification Forms G-1, G-3, G-4, G-5, and G-7 in response to the deficiencies and issues.

The Professional Team reviewed the following corrections to be included in the revised submission to be provided to the Commission no later than 10 days prior to the May 19-21, 2009 meetings:

- Pages 17-19, G-1.2, revised to include information from recently published papers and to include discussion of wind shear
- Pages 41-47, Forms G-1 through G-7 updated after review of submission revisions
- Pages 50-51, M-2, revised to include information from recently published papers and to clarify equations used
- Page 52, M-2.3, revised to be consistent with Form S-3

- Page 65, Form M-1 revised to be consistent with Form S-1
- Page 72, Form M-3, footnote added for clarification
- Page 77, V-1.D, revised to include reference to claims data from four insurers for 2004 and 2005 storms
- Page 79, V-1.8, revised to correct figure reference to Figure 16
- Page 83, Form V-1.C, revised to correct figure reference to Figure 17
- Pages 121-122, Form A-3 revised
- Pages 189-190, S-1.B, text and captions for Figures 41 and 42 corrected to all Tropical Cyclones
- Page 202, S-1.6, Figure 48 revised
- Page 205, Form S-2 revised
- Page 206, Form S-3, rationale revised
- Page 216, C-4.B, revised to include verification of data
- Pages 223-228, meteorological and vulnerability references updated

Additional Verification Review – June 1, 2009

ARA submitted revised Forms A-6, A-7, and A-8 on May 22, 2009 in accordance with the Form A-6 instructions contained in the Report of Activities. The Professional Team met with ARA on June 1, 2009 in Tallahassee to review the revisions in completing Form A-6, Output Ranges.

The following individuals participated in the additional verification review:

ARA
Francis M. Lavelle, Ph.D., P.E., Principal Engineer
Peter J. Vickery, Ph.D., P.E., Principal Engineer

Professional Team
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Donna Sirmons, Staff

ARA provided an explanation of the changes made to incorporate year built in the modeled exposure data used as the basis for completion of Form A-6, Output Ranges. All Standards remain verified.

Report on Deficiencies and Issues

The Professional Team reviewed the following deficiencies and issues cited by the Commission at the March 19, 2009 meeting. The issues were received and the deficiencies were corrected by the established time frames. The corrections have been verified.

Deficiencies:

1. Standard G-1 (page 17)
   In response to standard, no mention of probable maximum loss as part of the scope

2. Standard A-11 (page 116)
   No response to standard

3. Form A-9 (pages 185-188)
   No description provided on derivation of uncertainty intervals

Issues:

1. Revised Vulnerability Forms must be submitted by March 25, 2009

2. Revised Actuarial Forms must be submitted by March 25, 2009

3. Revised Statistical Forms must be submitted by March 25, 2009

Professional Team Pre-Visit Letter

The Professional Team's pre-visit letter questions are provided in the report under the corresponding Standards.

Pre-Visit Letter

The purpose of the pre-visit letter is to outline specific issues unique to the modeler's submission. The goal is to identify lines of inquiry to be followed during the on-site review so as to allow adequate advance preparation by the modeler. Aside from due diligence with respect to the full submission, various requests for information and questions that the Professional Team is certain to ask the modeler during the on-site review are provided in this letter. This letter does not preclude the Professional Team from asking for additional information during the on-site review that is not given below or discussed during the upcoming conference call that will be held, if requested by the modeler. One goal of the potential conference call is to clarify points in this letter. The comments are grouped by Standards sections. The overall intent is to expedite the on-site review and to avoid last minute preparations that could just as easily have been handled earlier.

The items provided below are to assist the modeler in preparing for the on-site review. Some of this material may have been shown or been available on a previous visit by the Professional

Team. The Professional Team will also be considering material in response to the Commission's designation(s) of deficiencies and issues.

The goal of the Professional Team on-site review is to provide the Florida Commission on Hurricane Loss Projection Methodology (Commission) with a clear and thorough report of the model, subject to non-disclosure restrictions on proprietary information. All modifications, adjustments, assumptions, or other criteria that were included in producing the information requested by the Commission in the submission should be disclosed and will be reviewed.

It is important that all material prepared for presentation during the on-site review, be presented using a medium that is readable by all members of the Professional Team simultaneously. The Professional Team will review selected computer code in conjunction with the reviews performed for each section. Computer code should be available in a format that will allow simultaneous visualization by the entire Professional Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Professional Team. The Professional Team should be provided access to an internet connection through one of the Professional Team member computers for reference work that may be required while on-site.

The Professional Team will interview the individuals signing the Expert Certification Forms G-1 through G-7.

Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since 2005. Describe any processes used to amend or validate the model that incorporates this engineering data. Describe any processes used to amend or validate the model that incorporates insurance company claims data covering the 2004 and 2005 hurricane seasons, especially processes used since the prior visit by the Professional Team.
Provide and describe all studies performed to determine whether the model meets the "probable maximum loss" requirements added to the standards in the 2008 Report of Activities (Standard A-11 and several other standards and forms).

Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission.

Demonstrate that output reports produced by a user of the model reveal the values of all user inputs and selections used to run the model.

When the Professional Team arrives on-site, provide the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

In light of the extension granted to you by the Commission and the receipt of new material prior to the visit, the Professional Team may identify some additional pre-visit letter type items which we will send on to you if they become available. In particular, if a query is identified in advance that would require considerable preparation time, we assume you would prefer to receive it in advance rather than at the opening briefing.

For your information, the Professional Team will arrive in business casual attire.

ISSUES:

Describe how the model incorporates number of stories in the vulnerability functions.

Discuss the development and application of mitigation credits for various parts of the state, by region (North, Central and South), and by proximity to water (Coastal and Inland) as defined in Form A-7. Expansion to structure types that resemble the actual Florida building stock is desired.

TRADE SECRET MATERIAL:

Describe how the model determines the magnitude of demand surge to include in the calculation of loss costs and probable maximum loss levels.

Show the Professional Team "supportive design diagrams, equations, and pseudo-code" that you intend to show the Commission during the closed meeting portion of the modeler presentation.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation*

*(*Significant Revision)*

The computer model shall project loss costs and probable maximum loss levels for personal lines residential property insured damage 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 insured loss costs and probable maximum loss levels. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.

2. All 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 and probable maximum loss levels (1) fall within the scope of the Computer Standards, and (2) will be reviewed interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each Standard).

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

Pre-Visit Letter

1. G-1, Disclosure 2, page 18: Clarify the role of shear in the intensity model.

2. G-1, Disclosure 2, page 18: Define exit relative to the change in intensity parameterization.

3. G-1, Disclosure 5, pages 21-22: Quantify the impact of the changes on statewide loss costs for items 1, 3, and 4.

4. G-1, Disclosure 5, page 22: Discuss the process and resulting new residential vulnerability functions indicated in items 3 and 4.

Trade Secret Information to be presented to the Professional Team (page 11):

- G-1, Disclosure 5 – The Professional Team will be shown documentation binders, validation studies and supporting information related to the model changes listed in our response to Disclosure 5 under Standard G-1.

Verified: YES

Professional Team Comments:

Reviewed the following updates to the model in detail and their impact on loss costs.

- Update to the hurricane model to include data from the 2007 hurricane season
- Update to the surface roughness model
- Wind tunnel data for roof loads
- Update to the building stock distributions used to weight and combine the residential vulnerability functions
- Update to the residential vulnerability functions
- Update to the attached and detached exterior structures vulnerability functions

Details provided under applicable standards.

Reviewed a graphical summary of the changes to the building stock and exterior structures, and the resultant losses compared to the previous year.

Discussed the role of shear in the intensity model and the definition of exit relative to the change in intensity parameterization. ARA revised the response to Disclosure 2 to be a more comprehensive discussion based on published papers.

Exit is defined as the storm center crossing the coast.

G-2 Qualifications of Modeler Personnel and Consultants*

*(*Significant Revision)*

A. Model construction, testing, and evaluation shall be performed by modeler personnel or consultants who possess the necessary skills, formal education, and 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 under consideration will be reviewed. Signatories on the individual Forms will be required to provide a description of their review process.

3. Discuss any 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

The Professional Team will interview the individuals signing the Expert Certification Forms G-1 through G-7.

5. G-2, Disclosure 2.B, page 31: Provide the resumes of the three new employees (Dr. Justin Chen, Dr. Antonio Rigato, and Dr. Bo Yu).

Verified: YES

Professional Team Comments:

Reviewed resumes of personnel new to this year's model:

- Yingzhao (Justin) Chen, Ph.D., Structural/Wind Engineering, University of Western Ontario; M.S., Structural/Wind Engineering, Tsinghua University; B.E., Civil/Hydraulic Engineering, Tsinghua University
- Antonio Rigato, Ph.D., Civil Engineering, University of Maryland; M.S., Civil Engineering, University of Maryland; B.S. Civil Engineering, University of Maryland
- Bo Yu, Ph.D., Civil Engineering, Florida International University, Miami, Florida; M.S., Atmospheric Physics & Atmospheric Environment, Lanzhou University, Lanzhou, P.R. China; B.S., Atmospheric Physics & Atmospheric Environment, Lanzhou University, Lanzhou, P.R. China

*****Additional Verification Review Comments*****

Reviewed updated Actuarial Standards Expert Certification Form G-4.

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.

3. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.

Information to be presented to the Professional Team:

- G-3.C, page 34 – Maps showing the ZIP Code boundaries and the associated centroids will be available to the Professional Team.

Verified: YES

Professional Team Comments:

Discussed the new methodology for including their adjusted ZIP Code boundaries in z_0 calculation. Reviewed method for automating this process to calculate z_0 values from land use and land cover at the ZIP Code level.

Reviewed maps showing the ZIP Code boundaries and the associated centroids. Reviewed comparisons of z_0 between the previous year and this year's version.

G-4 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.

Audit

1. Demonstrate that the model components adequately portray hurricane phenomena and effects (damage, loss costs, and probable maximum loss levels). 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:

There was no evidence to suggest that one component of the model was artificially adjusted to compensate for another component.

G-5 Editorial Compliance*

*(*Significant Revision due to new Audit language)*

The submission and any revisions provided to the Commission throughout the review process shall be reviewed and edited by a person or persons with experience in reviewing technical documents who shall certify on Form G-7 that the submission has been personally reviewed.

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2008*.

2. Describe all changes to the submission document since the prior year's submission that might impact the final document submission.

3. Demonstrate that the modeler submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and inclusion of extraneous data or materials.

4. The modification history for submission documentation will be reviewed.

5. A flowchart defining the process for Form creation will be reviewed.

6. Form G-7 will be reviewed.

Pre-Visit Letter

The Professional Team will interview the individuals signing the Expert Certification Forms G-1 through G-7.

6. G-5, Audit item 5 from page 73 of Report of Activities: Provide the flowchart used for Form creation.

Verified: YES

Professional Team Comments:

Reviewed flowchart describing submission form creation.

Discussed with Janet MacKenzie her process for editorial review and the ARA submission assembly process.

Editorial items noted by the Professional Team were satisfactorily addressed during the audit. The Professional Team has reviewed the submission per Audit item 3, but cannot guarantee that all editorial difficulties were identified. The modeler is responsible for eliminating such errors.

*****Additional Verification Review Comments*****

Reviewed updated Editorial Certification Form G-7.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in the model and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 1, 2008 (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.

B. Any trends, weighting or partitioning shall be justified and consistent with currently accepted scientific literature and statistical techniques. Validation and comparison shall encompass the complete Base Hurricane Storm Set as well as any partitions.

Audit

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

2. Reasoning and justification underlying any modification by the modeler to the Base Hurricane Storm Set will be reviewed.

3. Reasoning and justification underlying any short-term and long-term variations in annual storm frequencies incorporated in the model will be reviewed.

4. Modeled probabilities will be 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.

5. Form M-1 will be reviewed for consistency with Form S-1.

6. Comparisons of modeled probabilities and characteristics from the complete historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against the complete historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

Pre-Visit Letter

7. Form M-1, page 65: Discuss the low frequencies of Cat3 to Cat5 storms (deficits of 20% or more) in most regions.

Verified: YES

Professional Team Comments:

Verified that the June 2008 version of HURDAT for years 1886-2007 was incorporated for Florida and adjacent states. Verified that modeled frequencies in Form M-1 are determined using maximum windspeed at landfall.

Discussed the low frequencies in Form M-1 of Category 3 to Category 5 storms in most regions. ARA stated that comparisons to the National Hurricane Center (NHC) estimates of windspeeds suggest to them that the NHC tends to overestimate landfall intensity in recent years (since the late 1970s).

Discussed results from Powell et al. (2009) suggesting larger decreases in flight-level to surface winds than inferred from previous studies.

Discussed that these results do not apply to windspeed estimates for earlier storms.

Discussed use of HURDAT data in conditioning the modeled storm set.

Reviewed and resolved the discrepancies in modeled frequencies between Form M-1 and Form S-1.

“Entire State” counts in Form M-1 corrected for multiple landfalls. Verified that Forms M-1 and S-1 are now consistent.

Reviewed a complete set of storm tracks and storm parameters along each track for all storms affecting Florida and adjacent states, for both the 2007 Report of Activities and 2008 Report of Activities submissions. Reviewed a summary table of all changes. Later storm intensities were decreased following Powell et al. (2009). This resulted in consequent changes in diagnosed Holland B.

Reviewed analysis of Form M-1 for statistical agreement between frequencies.

M-2 Hurricane Parameters and Characteristics

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

Audit

1. All hurricane parameters used in the model will be reviewed.

2. Prepare graphical depictions of hurricane parameters as used in the model. Describe and justify:
   - the data set basis for the fitted distributions,
   - the modeled dependencies among correlated parameters in the windfield 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 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.

5. All modeler cited scientific literature provided in Standard G-1 will be reviewed to determine applicability.

6. All external data sources that affect model generated windfields will be identified and their appropriateness will be reviewed.

7. Describe the value(s) of the far-field pressure used in the model and approximate its sensitivity on the average annual zero deductible statewide loss costs.

Pre-Visit Letter

8. M-2, page 50: Provide equation (1a).

9. M-2, page 51: Provide the complete form of equation (2).

10. M-2, pages 50-51: Discuss the potential impact on intensity due to sampling the SST and shear years independently.

Verified: YES

Professional Team Comments:

Discussed the small changes to the Holland B parameter and Rmax made to the historical storms and the adjustments made to landfall windspeed from those provided in HURDAT.

Confirmed that sea surface temperature and shear are drawn from the same historical year when developing the modeled storm set.

ARA substantially revised the response to Standard M-2 to reflect additional details as given in their recent publications.

M-3 Hurricane Probabilities

A. Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.

B. Modeled hurricane probabilities shall 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. Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.

2. Describe and support the method of selecting stochastic storm tracks.

3. 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.

4. Provide any modeler specific research performed to develop the functions used for simulating model variables or to develop databases.

Pre-Visit Letter

11. M-3, Disclosure 1, page 55: Identify the reanalysis database used and provide reference.

Verified: YES

Professional Team Comments:

Discussed the reanalysis databases used and their references. The submission was revised to reflect these updates.

M-4 Hurricane Windfield Structure

A. Windfields generated by the model shall be consistent with observed historical storms affecting Florida.

B. The translation of land use and land cover or other source information to geographic surface roughness distribution shall be consistent with current state-of-the-science.

Audit

1. Provide any modeler-specific research performed to develop the windfield functions used in the model. Identify the databases used.

2. Provide any modeler-specific research performed to derive the roughness distributions for Florida and adjacent states.

3. The spatial distribution of surface roughness used in the model will be reviewed.

4. Identify other variables in the model that affect over-land surface windspeed estimation.

5. Provide detailed comparisons of the model windfield with Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005).

6. For windfield and/or pressure distributions not previously reviewed, the modeler will present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable windfield characteristics.

7. Form M-2 will be reviewed.

Pre-Visit Letter

12. M-4, Disclosure 1, page 56: Identify the average historical parameters relevant to Figure 7.

13. M-4, Disclosure 5, page 57: Discuss the effect of forward speed in the context of equation (6) on page 60.

14. M-4, Disclosure 6, page 57: Discuss the relevance of the NLCD released on 4/25/2007 to the model submitted.

15. Form M-2, pages 68-71: Discuss the relative magnitudes of the state-wide wind maxima between the historical reconstruction and the return period analyses.

16. Form M-2, pages 68-71: Justify the relative locations of the state-wide wind maxima for “local” and “open” terrain within each pair of analyses.

17. Form M-2, page 69: Justify how maximum winds are in some cases in the interior ZIP Codes with local terrain.

Verified: YES

Professional Team Comments:

Reviewed the surface roughness update. The basic approach was unchanged for most cases and data used were unchanged from the previous model. The process was automated and conducted on a county by county basis. The equations used to determine mapping values for developed open space and developed low intensity were revised.

Reviewed the land use land cover reclassification from the previous 1992 data to the NLCD 2007 data with new data layers and change in percent tree canopy coverage.

Reviewed the mapping for use of the tree canopy data with the land use and land cover data. Reviewed the calculation of z_0 by ZIP Code.

Reviewed new equations used for mapping developed open space and developed low intensity.

Reviewed comparison of 2007 mapping to 2008 mapping of the effect of tree canopy on developed open space.

Reviewed scatter plot of the change in each ZIP Code on the effect of changing the z_0 equation for land use and land cover in developed open space and developed low intensity.

Reviewed overall comparison on the change from 2007 z_0 to the 2008 z_0 calculation. Reviewed area verification by ZIP Code. Reviewed potential ZIP Code outliers and their cause.

Reviewed impact of the 2008 surface roughness updates on loss costs.

Reviewed the average historical parameters provided in Figure 7.

Reviewed the effect of forward speed in the context of equation (6).

Reviewed the maximum historical wind values and the modeled 100-year return period wind values in Form M-2 and the rationale for the largest historical value being larger than the largest 100-year value.

Reviewed the location and justification for the maximum winds in Form M-2. Discussed how interior ZIP Codes with low z_0 values could produce higher winds than near coastal locations with higher z_0 values.

Maps and tables of changes in storm parameters (see Standard M-1) were compared to the historical maps in Form M-2 for the current and previous year's submission. Verified

that the changes in Form M-2, Figure 12 are consistent with the changes in storm parameters.

M-5 Landfall and Over-Land Weakening Methodologies

A. The magnitude of land friction coefficients shall incorporate current geographic surface roughness distributions and shall be implemented with appropriate geographic information system data.

B. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records.

C. Models shall use maximum one-minute sustained 10-meter windspeed 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 windspeed shall be within the range of windspeeds (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

1. Describe the variation in over-land decay rates used in the model.

2. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.

3. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed.

Verified: YES

Professional Team Comments:

Verified no change in the over-land weakening rate methodology.

Perused visual basic scripts developed for recalculation of developed open space and developed low intensity z_0.

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 mean windspeed 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

18. Form M-3, page 72: Discuss the large variation of $R_{>40mph}$ across pressure bins.

19. Form M-3, pages 72-73: Justify the upper bound for Rmax in Figure 15 as it relates to the table.

Verified: YES

Professional Team Comments:

Discussed the differences in the data for the table in Form M-3 and the plots in Figure 15. The data in the table and the plots were derived from separate analyses with a different number of samples.

Reviewed the variation of $R_{>40mph}$ across the pressure bins.

Discussed the determination of the lower bound for the 110mph radius. An explanation for these entries based on the method of analysis was included in the submission.

Discussed the use of red and black points to indicate values beyond 1.5 or 3.0 times the inter-quartile range in Figure 15.

VULNERABILITY STANDARDS – Masoud Zadeh, 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, and 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 justified.

F. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and additional living expense.

G. The minimum windspeed that generates damage shall be reasonable.

Audit

1. Historical data shall 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 shall be available for review.

2. Copies of any papers, reports, and studies used in the development of the vulnerability functions shall 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 shall be available. The magnitude of logical changes among these items for a given windspeed shall be explained and validation materials shall 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. If age of building is used as a surrogate for building code and code enforcement, provide complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s).

6. Provide validation material for the disclosed minimum windspeed. Provide the computer code showing the inclusion of the minimum windspeed at which damage occurs.

7. The effects on building vulnerability from local construction characteristics and building codes will be reviewed.

8. Form V-1 will be reviewed.

Pre-Visit Letter

20. V-1, Disclosure 2, page 77: Discuss all the actual insurance claims data, including those related to the latest Florida storms, if any.

From preamble: Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since 2005. Describe any processes used to amend or validate the model that incorporates this engineering data. Describe any processes used to amend or validate the model that incorporates insurance company claims data covering the 2004 and 2005 hurricane seasons, especially processes used since the prior visit by the Professional Team.

21. V-1, Disclosure 6, page 78 (new this year): Describe the process of examining the building code revisions and enforcement and their impact on the vulnerability model, including Florida Building Code Revisions 2001, 2004, and their supplements/amendments.

22. Form V-1, page 83: Discuss variations in values for Parts A and B from the previous submission.

ISSUE:
Describe how the model incorporates number of stories in the vulnerability functions.

Verified: YES

Professional Team Comments:

Reviewed the vulnerability model updates:

- Loads and damage for site-built structures for various roof slopes and window, wall, and door leakage model
- Loss models including exterior accessory, tree debris and tree debris removal, roof cover damage, and full cover replacement
- Exterior structures model which had the largest impact on the vulnerability functions

Reviewed new wind tunnel data for pressure distribution over various roof slopes.

Discussed the two-step approach to vulnerability modeling going from physical damage to dollar losses.

Reviewed definitions of the pressure coefficients. Peak gust wind speeds at the mean roof height are used.

Reviewed the methodology for modeling pressure coefficients for gable, hip, and flat roofs with various roof slopes, and the interpolation between slopes. Reviewed the different zone pressure coefficients.

Discussed the use of wind tunnel test data for development of modeling peak pressure coefficients on low-rise building roof panels.

Reviewed the various pressure zones for flat roofs, gable roofs, and hip roofs. Reviewed comparisons of the current version to the previous version. Discussed the new data used to determine the loads and the rationale for shifting to the new data obtained from wind tunnel tests.

Reviewed comparisons of modeled pressure coefficient data to corresponding wind tunnel coefficients for various roof zones.

Reviewed flowchart for implementation of roof pressure coefficients. Verified no scaling according to various building codes and standards is performed.
Reviewed comparisons of contours of peak pressure coefficients for 1-story gable 7:12, 1-story hip 7:12, and 1-story flat in open terrain for roof pressure coefficient estimation versus wind tunnel results. Discussed reasons for differences between example plots.

Reviewed scatter plot comparisons of modeled peak pressure coefficients in 36 directions and wind tunnel results for 1-story gable 7:12, 1-story hip 7:12, and 1-story flat in open terrain.

Reviewed leakage model calculation for window, wall, and door leakage. Reviewed coefficient definitions for volume of air infiltration as a function of exterior area and external and internal pressures.

Reviewed the methodology for going from the volume of rain getting inside the building to loss to the building and contents.

Reviewed new vulnerability function for exterior accessory losses. Examples of exterior accessories are vents, built-in porches, fixtures, exterior trim, HVAC, plumbing, electrical, and built-in carports.

Reviewed loss due to non-modeled damage for the building exterior accessory components which sustain damage but are not explicitly modeled.

Reviewed comparisons between exterior accessory losses and other building losses for weak, average, and strong buildings.

Reviewed the content loss ratio due to fenestration damage.

Reviewed the model for the “low end losses” that were developed from detailed claims data review from Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Jeanne (2004), Hurricane Ivan (2004), and Hurricane Wilma (2005) from four different insurance companies.

Reviewed claim frequency analysis graph for the probability of loss function comparing the peak gust windspeed versus the probability of loss.

Reviewed validation of exterior accessory loss versus windspeed comparing claims data losses to the average claims data loss and the average modeled loss.

Reviewed exterior accessory loss value distribution by windspeed.

Reviewed flowchart of the manual process for exterior accessory loss verification.

Reviewed methodology and verification for tree debris and tree debris removal losses. Reviewed lognormal tree loss distribution fit.

Reviewed changes made to the roof cover damage costing by implementing a roof cover repair versus replacement factor.

Reviewed update to the full roof cover replacement model and the logistic regression analysis of reviewed closed claims relating to roof cover replacement. Reviewed statistical fitting plot of the logistic functions for shingle and tile roofs.

Reviewed roof replacement flowchart and a revised flowchart to incorporate the roof replacement factor.

Reviewed impact of the 2008 vulnerability model updates on loss costs.

Reviewed new exterior structure loss model based on ARA exterior structures survey and research project for the Florida Office of Insurance Regulation in 2007.

Reviewed new vulnerability functions for attached and detached structures. Attached structure model is based on a failure probability curve and the detached structure model is based on insurance data.

Reviewed exterior structure loss model flowchart.

Reviewed validation for the attached structure loss vulnerability curve using data from Hurricane Charley (2004) and Hurricane Wilma (2005).

Reviewed the derivation and methodology for the detached structure loss functions.

Reviewed complete set of detached structure loss functions for five terrain types with tile roof cover and shingle roof cover.

Reviewed comparison of detached structure loss functions with insurance data.

Reviewed value determination for single family detached structure loss developed from an exterior structure survey of site built homes. Reviewed validation by using a beta distribution fit for each attached and detached structure categories.

Reviewed value determination for manufactured home detached structure loss developed from exterior structures survey of manufactured homes. Reviewed validation by using a beta distribution fit to attached and detached only.

Reviewed graph of exterior structure frequency for none, attached only, attached and detached, and detached only exterior structures.

Reviewed update to Florida building stock model based on site inspections performed during 2006 and 2007 under the My Florida Safe Home program.

Reviewed weights for various building features and characteristics for developing Florida building stock representation.

Reviewed hip roof shape comparison to prior years for southeast Florida after update to the Florida building stock model.

Reviewed sample tables of roof cover type and strength by era and region. Reviewed number of inspections for building stock weighting by region and era.

Reviewed sample building stock weighting file for implementation of roof cover type and strength by era and region into the model.

Reviewed impact of building stock weighting changes on loss costs. Reviewed scatter plot of ground up loss costs by ZIP Code for owners frame. Reviewed contour map of resulting loss costs changes.

Reviewed comparisons between the updated model and the previous model for various construction parameters by region and era for modeled Coverage A losses. Discussed the insights into the model provided by the results.

The response to Disclosure 2 was revised to include claims data from 4 different insurers for 2004 storms Charley, Frances, Ivan, and Jeanne and 2005 storm Wilma.

Discussed the process for examining and enforcement of changes to the Florida Building Code. Enforcement is not explicitly considered. Changes to the building code are taken into account in the building stock modeling using year built as an indicator.

Verified the revised Form V-1 was completed assuming no attached or detached exterior structures. The changes in Form V-1 from the previous year are related to the updates to the damage and loss models.

Reviewed changes to code ResComLossV6 as it pertains to "low end loss" due to exterior accessory features update.

Reviewed conversion from air volume to water volume.

Reviewed routines for building value computation.

Reviewed comparison of exterior structure model update on average annual loss for various regions of Florida.

Documentation reviewed:

- HurLoss Risk Analysis Suite, Building Component Load Models, Volume II-A
- HurLoss Risk Analysis Suite, Individual Building Damage Model, Part I, Volume II-B
- HurLoss Risk Analysis Suite, Individual Ground-Up Building Loss, Volume II-E
- HurLoss Risk Analysis Suite, Analysis of Florida Building Stock, Volume III-A3
- HurLoss Risk Analysis Suite, Terrain Database, Volume III-B
- Evaluation and Report on the Insurability of Attached and Free Standing Structures, Final Report prepared for Florida Office of Insurance Regulation, ARA Project 17819, May 1, 2007

V-2 Mitigation Measures

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 empirically justified both individually and in combination.

Audit

1. Forms V-2 and V-3 provide the information used in auditing this Standard.

2. Individual mitigation measures as well as their effect on damage due to use of multiple mitigation measures will be reviewed. Any variation in the change over the range of windspeeds for individual and multiple mitigation measures will be reviewed.

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

When the Professional Team arrives on-site, provide the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

23. Form V-2, page 87: Explain the updated Form V-2 in lieu of changes to residential vulnerability functions. Explain the trend of impact of various mitigation measures with windspeed.

24. Form V-2, page 87: Discuss the value for braced gable ends for winds over 100 mph with reference to the statement at the top of page 76.

ISSUE:
Discuss the development and application of mitigation credits for various parts of the state, by region (North, Central and South), and by proximity to water (Coastal and Inland) as defined in Form A-7. Expansion to structure types that resemble the actual Florida building stock is desired.

Verified: YES

Professional Team Comments:

Reviewed the values in Form V-2 as a result of the changes to the vulnerability functions. Verified the exterior structure changes had no impact on Form V-2.

Discussed the application of one-at-a-time mitigation measures.

Reviewed Form V-3 and confirmed consistency with the submitted Form V-2.

Reviewed the methodology for braced gable ends.

Discussed building code revisions and enforcement.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs and Probable Maximum Loss Levels*

*(*Significant Revision)*

Modeled loss costs and probable maximum loss levels shall reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds 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

25. A-1, Disclosure 2, page 89 (new this year): Provide details (including data used) regarding the process described related to the appropriate accounting for preceding flood or hurricane storm surge.

26. A-1, Disclosure 3, page 89 (new this year): In conjunction with the response to Disclosure 2 above, provide additional details regarding this response.

Verified: YES

Professional Team Comments:

Verified that storm surge is not considered in the model except for ALE.

Verified no change in the definition of an event or a by-passing storm.

A-2 Underwriting Assumptions*

*(*Significant Revision)*

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 and probable maximum loss level 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 appropriate.

Audit

1. 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" or claim practices of insurers with respect to concurrent causation.

Verified: YES

Professional Team Comments:

Discussed the incorporation of the 2004 and 2005 hurricane season insurance claims data in the model. Discussed the insurance companies' claim payment practices and handling of claim files when no payment was made (i.e., claim does not reach deductible) and claims identified with minimum charges. Discussed repair versus replacement costs for roof damage.

Reviewed several individual claim files. Discussed the method for collecting and processing the claim files data. Discussed handling of insurer coding errors in the data collection scheme.

A-3 Loss Cost Projections and Probable Maximum Loss Levels*

*(*Significant Revision)*

A. Loss cost projections and probable maximum loss levels 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 and probable maximum loss levels shall not make a prospective provision for economic inflation.

C. Loss cost projections and probable maximum loss levels shall not include any provision for direct hurricane storm surge losses.

Audit

1. 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 modeled loss costs do not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin, and the model does not make a prospective provision for economic inflation.

A-4 Demand Surge*

*(*Significant Revision)*

A. Demand surge shall be included in the model's calculation of loss costs and probable maximum loss levels using relevant data.

B. The methods, data, and assumptions used in the estimation of demand surge shall be actuarially sound.

Audit

1. Provide the data and methods used to incorporate individual aspects of demand surge on each coverage type, inclusive of the effects from building material costs, labor costs, contents costs, repair time, etc.

2. All referenced literature will be reviewed to determine applicability.

Pre-Visit Letter

TRADE SECRET MATERIAL: Describe how the model determines the magnitude of demand surge to include in the calculation of loss costs and probable maximum loss levels.

Verified: YES

Professional Team Comments:

Verified no change in the methodology for demand surge calculations from the previous year.

A-5 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 shall 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

Demonstrate that output reports produced by a user of the model reveal the values of all user inputs and selections used to run the model.

Verified: YES

Professional Team Comments:

Discussed with Doug Collins his confidence that all user inputs and selections used to run the model are handled properly and that this information is provided on the model output reports.

A-6 Logical Relationship to Risk*

*(*Significant Revision due to new Form)*

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 the quality of construction type, materials and workmanship increases, all other factors held constant.

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

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

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

G. 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, and A-5 will be used to assess coverage relationships.

Pre-Visit Letter

27. Form A-3, pages 121-122: Explain the non-zero entry for Hurricane Rita (2005). Explain the large reduction in losses for some of the storms relative to the previous submission.

Verified: YES

Professional Team Comments:

Reviewed a revised Form A-3 which includes Florida losses for Hurricane Rita (2005) after correcting the storm track selected for Hurricane Rita (2005).

Reviewed changes in losses in Form A-3 from previous year. All historical storms were re-visited and small changes to the Holland B parameter and Rmax were made to many of the historical storms. In addition to the change in historical storm parameters, the changes in losses were attributed to the changes in the vulnerability functions and the building stock weighting.

A-7 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.

C. Deductible loss costs shall be calculated in accordance with s. 627.701(5)(a), F.S.

Audit

1. Describe the process used to determine the accuracy of the insurance-to-value criteria in data used to develop or validate the model results.

2. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for handling deductibles and policy limits.

3. 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.
4. Justify changes from the prior submission in the relativities among corresponding deductible amounts for the same coverage.

Verified: YES

Professional Team Comments:

Verified no change in the process for calculating and applying deductibles and policy limits. Deductible calculations are in compliance with s. 627.701(5)(a), F.S.

A-8 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

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for contents coverage.

2. 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.

3. 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:

Reviewed the change in contents loss costs. Reviewed comparisons between the previous and the current model for contents losses for different regions.

Reviewed the content loss ratio due to fenestration damage. Reviewed the process for determining damage to contents based on the volume of rain infiltrating the building when the windows and doors remain intact.

A-9 Additional Living Expense (ALE)

A. The methods used in the development of 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 (1992);
    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:

Reviewed the change in ALE loss costs and the underlying causes.

A-10 Output Ranges

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

B. All other factors held constant, output ranges produced by the model shall reflect lower loss costs for:

1. masonry construction versus frame construction,

2. residential risk exposure versus mobile home risk exposure,

3. in general, inland counties versus coastal counties, and

4. in general, northern counties versus southern counties.

Audit

1. Forms A-6, A-7, and A-8 will be reviewed.

2. The modeler will be required to justify all changes from the prior submission using the 2007 Florida Hurricane Catastrophe Fund aggregate exposure data.

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

Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission.

28. A-10, Disclosure 2, pages 107-115: Discuss the predominance of changes of order and in excess of 50%.

29. A-10, Disclosure 2, page 111: Discuss the increases in ALE corresponding to large decreases in other coverage types for mobile homes (and not consistent with other building types).

Verified: YES

Professional Team Comments:

Reviewed impact of building stock weighting changes on loss costs. Reviewed scatter plot of ground up loss costs by ZIP Code for owners frame. Reviewed contour map of resulting loss costs changes.

Discussed with Doug Collins his review and his understanding of the changes in loss costs as a result of the updates to the model.

Reviewed the effect of the model updates on manufactured home losses. Reviewed comparisons between the previous and the current model for manufactured home losses for different zones.

Reviewed impact of each change in the model on each loss cost category.

*****Additional Verification Review Comments*****

Reviewed incorporation of year built in the modeled exposure data for Forms A-6, A-7, and A-8. Discussed the changes made in form generation.

Discussed the rationale for the shifts in percentage changes in the revised output ranges.

Discussed the relationship between structure and contents loss costs.

Reviewed percentage changes in ALE for renters masonry in Table 3e.

Reviewed percentage changes in condo owners frame for Suwannee County in Form A-8, Figure 38.

Reviewed percentage changes in renters masonry for Lafayette County in Form A-8, Figure 37.

A-11 Probable Maximum Loss*

*(*New Standard)*

The methods, data, and assumptions used in the estimation of probable maximum loss levels shall be actuarially sound.

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-9.

2. All referenced literature will be reviewed to determine applicability.

3. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedures used for calculating probable maximum loss levels.

Pre-Visit Letter

Provide and describe all studies performed to determine whether the model meets the "probable maximum loss" requirements added to the standards in the 2008 Report of Activities (Standard A-11 and several other standards and forms).

Verified: YES

Professional Team Comments:

Discussed with Doug Collins his review of the data and methods used for probable maximum loss levels.

Reviewed the formula used to produce probable maximum loss levels and the uncertainty intervals.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit*

*(*Significant Revision due to new Form and Audit language)*

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 in the appropriate disciplines.

Audit

1. Forms S-1, S-2, and S-3 will be reviewed. Provide justification for the distributions selected including, for example, citations to published literature or analyses of specific historical data.

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

Pre-Visit Letter

30. S-1.A, page 189: Clarify whether storms with winds less than the damage threshold on land are included in this count.

31. S-1, Disclosure 2, page 190: Clarify the use of the 1886-2006 time period used for frequencies in Florida.

32. S-1, Disclosure 4, page 191: Provide the validation/verification insurance company data on 2004 and 2005 storms.

Verified: YES

Professional Team Comments:

Reviewed goodness-of-fit tests and validation comparisons for roof pressure coefficient, exterior accessory losses, tree debris and tree debris removal, logistic regression functions for shingle and tile roofs, and attached and detached structures for single family and manufactured homes.

Verified that computer code implementations agreed with statistical documentation.

Reviewed beta parameter estimation for exterior accessory damage and the exterior accessory data for beta distribution fit for maximum windspeeds.

Identified parts of the supporting documentation that were incomplete or in error. All such material was corrected while the Professional Team was on-site.

Discussed the storms included in Figures 41 and 42. The counts may include storms with winds on land less than the damage threshold. The captions for Figures 41 and 42 were revised to indicate all Tropical Cyclones, not restricted to Tropical Storms.

Verified the use of HURDAT from 1886-2006 for the development of the track model and the use of HURDAT through 2007 for validation.

Reviewed ZIP Code comparisons of modeled versus actual losses for Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005) from three different insurance companies.

Reviewed rationale for the stochastic hurricane parameters provided in Form S-3. Form S-3 revised to reflect the rationale discussed.

Reviewed and resolved discrepancies in modeled frequencies between Form M-1 and Form S-1.

Reviewed revised 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 in the appropriate disciplines 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-6 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

The model updates did not necessitate an update to Form S-6. Verified no new sensitivity tests were performed since the previous year.

Discussed the benefits of preliminary sensitivity analyses for directing future work.

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 in the appropriate disciplines 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-6 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

The model updates did not necessitate an update to Form S-6. Verified no new uncertainty tests were performed since the previous year.

Discussed the benefits of preliminary uncertainty analyses for directing future work.

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

1. 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 revised maximum standard error of 2.2%. Verified no change in the process of sample size determination nor the need to adjust the simulation sample size.

S-5 Replication of Known Hurricane Losses

The model shall estimate 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 windfield applied to a particular hurricane for the purpose of validation and the windfield used in the model under consideration,
h. The type of property used in each hurricane to address:
    1. Personal versus commercial
    2. Residential structures
    3. Mobile homes
    4. Condominiums
    5. Structures only
    6. 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-4 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 average annual loss comparisons for exterior structures. Reviewed spreadsheet with examples of loss costs for different exterior structure scenarios for several regions.

Reviewed revised comparisons of modeled and actual total losses by storm and company for residential coverage.

Reviewed comparisons of modeled and actual losses for Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).

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-5 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 windfield, 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

Professional Team Comments:

Reviewed revised Form S-5 and compared results with Form A-3.

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 and dated.

C. The modeler shall maintain (1) a table of all changes in the model from the prior year's submission to the initial submission this year and (2) a table of all substantive changes since this year's initial submission.

D. 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, verification) 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.

6. The tables specified in C-1.C that contain the items listed in Standard G-1, Disclosure 5 will be reviewed. The tables shall contain the item number in the first column. The remaining five columns shall contain specific document or file references for affected components or data relating to the following Computer Standards: C-2, C-3, C-4, C-5, and C-6.

7. Trace the model changes specified in Standard G-1, Disclosure 5 through all Computer Standards.

Pre-Visit Letter

33. C-1.C, page 213: Relate the table of contents with the response to Standard G-1, Disclosure 5 on pages 21-22 by demonstrating individual table item compliance with the Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Reviewed the HurLoss Risk Analysis Suite, Primary Document Binder.

Reviewed documentation defining aspects of:

- Roof pressure coefficients
- Window and door leakage
- Exterior accessory loss
- Tree debris and tree debris removal
- Roof replacement
- Exterior structures – attached and detached
- Building stock weighting

Reviewed the table of all changes in the model from the previous year's submission.

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

1. 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 revised requirements documentation related to:

1. updated table to include the 2007 storms
2. update to the surface roughness model
3. update to the residential vulnerability functions
4. update to the building stock weights
5. update to the attached and detached exterior structures vulnerability functions

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, shall be available for the review of each component.

Verified: YES

Professional Team Comments:

Reviewed flowchart for implementation of roof pressure coefficients.

Reviewed roof replacement flowchart.

Reviewed exterior structure loss model flowchart.

Reviewed exterior accessory loss verification flowchart.

Reviewed the flowchart for developing terrain roughness by ZIP Code.

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.

F. The modeler shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosure 5:

1. A list of all equations and formulas used in documentation of the model with definitions of all terms and variables.

2. A cross-referenced list of implementation source code terms and variable names corresponding to items within F.1.

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:
    a. component name,
    b. date created,
    c. dates modified and by whom,
    d. purpose or function of the component, and
    e. 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 C++ code for exterior accessory loss.

Reviewed C++ code for the logistic regression model.

Reviewed C++ code for tree debris and tree debris removal losses.

Reviewed Visual Basic code for the land use and land cover terrain z_0 update resulting in a more automated process than in the previous year.

Reviewed Fortran code used to calculate pressure coefficients on flat, gable, or hip roofs of low-rise buildings.

Reviewed updates to the C++ code to estimate leakage model coefficients of leakiness for a given wall, window, or perimeter type.

Reviewed the table of all software components affecting loss costs which included the component name and number of lines of code and comments.

Reviewed fitting of the beta distribution in conjunction with cross references between the equations and code.

Reviewed a table containing equations, formulas, variable definitions, and the corresponding code equivalent for items listed in Standard G-1, Disclosure 5.

*****Additional Verification Review Comments*****

Reviewed coding changes for the generation of Form A-6, Output Ranges.

Reviewed query processing used for form generation.

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. Verification procedures shall include tests performed by modeler personnel other than the original component developers.

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 including compliance with independence of the verification procedures.

Verified: YES

Professional Team Comments:

Reviewed verification approaches including 1) comparing 2007 versus 2008 roughness values, and 2) implementing ZIP Code area cross-checks.

Reviewed a verification approach, specified as a flowchart, associated with the calculation of exterior accessory loss costs.

Reviewed a checksum verification of an example site inspection mitigation spreadsheet for building stock weighting coefficients.

Reviewed method for verification of beta distribution fits.

C-6 Model Maintenance and Revision*

*(*Significant 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.

D. The modeler shall maintain a list of all model versions since the initial submission for this year. Each model description shall have a unique version identification, and a list of additions, deletions, and changes that define that version.

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 shall 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.

4. The list of all model revisions as specified in C-6.D will be reviewed.

Pre-Visit Letter

34. C-6.D, page 220: Provide the model version history leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed the ARA Policy for model revision. Verified no change from the previous year.

Reviewed the rules used by the modeler for model and code version numbering. Reviewed the model version history leading up to HurLoss 4.2.a.

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:

Verified no change from the previous year with regard to security procedures.