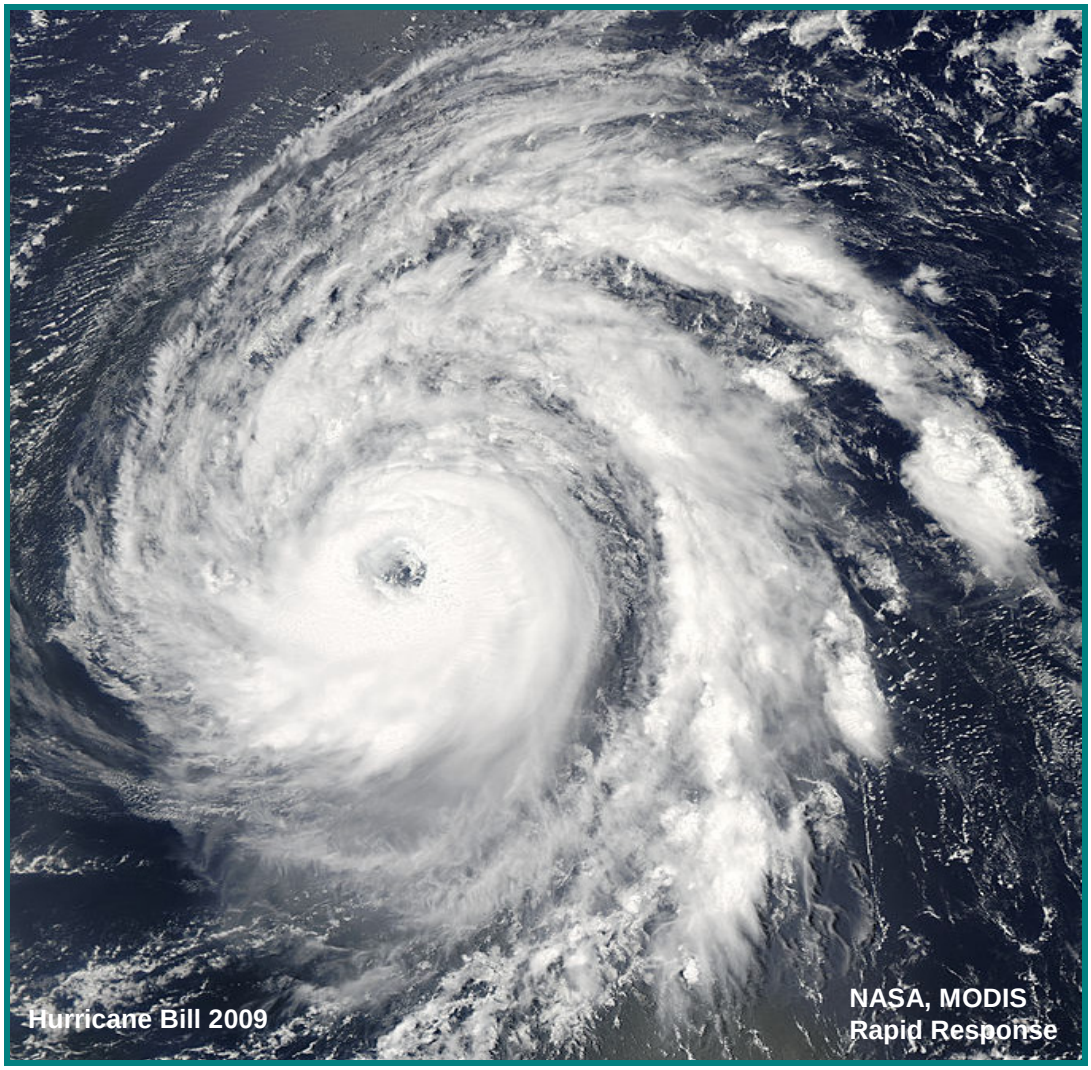
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2009 Standards

Applied Research Associates, Inc.

On-Site Review
February 1-4, 2011

On February 1-4, 2011, the Professional Team visited on-site at Applied Research Associates, Inc. (ARA) in Raleigh, North Carolina. The following individuals participated in the review:

ARA
Francis M. Lavelle, Ph.D., P.E., Vice President
Joseph Lebens, Actuarial Consultant (via phone)
William L. Ratliff, Jr., Senior Scientist/Group Leader
Antonio Rigato, Ph.D., P.E., Senior Scientist
Jeffrey C. Sciaudone, P.E., Senior Scientist
Peter J. Vickery, Ph.D., P.E., Principal Engineer
Dhiraj Wadhera, Senior Scientist
Lisa West, Division Administrator

Professional Team
Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Greg McLellan, P.E., Structural Engineer
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 presentation of the changes made in the 2010 model (HurLoss Version 5.0):

- Changes implemented to the computational approach used to model expected losses, including the effects of coinsurance, limits, deductibles, and demand surge
- Storm set updated to include data from the 2009 hurricane season
- ZIP Code database and boundaries updated to use December 2009 ZIP Code data
- Commercial-residential high-rise damage functions included in the submission.

The Professional Team reviewed the following corrections to be included in the revised submission which is to be provided to the Commission no later than 10 days prior to the meetings for reviewing models for acceptability:

- Page 21, G-1.2, “an updated version of that” deleted in first sentence under Hurricane Windfield Model
- Page 24, G-1.5.A, response revised to include ground-up losses and kilometers converted to miles
- Page 25, G-1.5.G, Figure 3 replaced
- Page 33, G-2.2.B, response corrected to include actuarial consultant, Joseph Lebens and technical editor, Lisa West
- Page 54, M-2, reference date for Vickery et al. corrected
- Page 62, M-4.6, “the air-sea temperature difference” deleted
- Page 70, Form M-1.F, correct form reference number
- Page 78, Form M-3 corrected to include Florida storms only
- Page 81, V-1.B, response revised to address uncertainties associated with the development of the vulnerability functions

- Page 83, V-1.2, corrected to include commercial residential loss data
- Page 93, Form V-2, statement added on assumption of winds in completing form
- Page 114, A-10.2, additional explanation of "DIV/0"
- Page 216, S-1.2, corrected storm names and years
- Page 218, S-1.6, Vickery et al. reference date corrected and kilometers converted to miles
- Page 224, S-4, corrected Figure 55 and the range of standard errors
- Page 226, S-4.1, corrected maximum standard error percentage
- Page 231, Form S-2, corrected column headings and file reference in instructions
- Page 232, Form S-3 revised to include negative binomial distribution for occurrence rate
- Page 259, G-1.4, corrected Vickery et al. reference dates

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the December 14, 2010 meeting. The deficiencies were corrected within the established time frame, and the corrections have been verified.

1. Standard G-1, Disclosure 4 (page 23)
   James and Mason (2005) reference under Standard S-1 not provided in References

2. Standard G-1, Disclosure 5.A (page 24)
   Summary description not provided for significant change A.(1)

3. Standard A-5, Disclosure 2 (page 102)
   Optional features of the model and variables that the model user is authorized to set in using the model are not addressed

4. Standard A-5, Disclosure 3 (page 103)
   No description provided on the process followed by the user to generate the model output produced from the input form

5. Form S-4.B (page 233)
   Validation comparison for commercial residential not provided

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, and to identify lines of inquiry to be followed during the on-site review so as to allow adequate preparation by the modeler. Aside from due diligence with respect to the full submission, various

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 an 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.

Some of this material may have been shown or may have been available on a previous visit by the Professional Team. The Professional Team will also be considering material in response to deficiencies and issues designated by the Florida Commission on Hurricane Loss Projection Methodology (Commission).

The goal of the Professional Team on-site review is to provide the 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 presentation during the on-site review is recommended to proceed in the following sequence: (1) new, or updated, material related to the model; (2) responses to the pre-visit letter questions and issues; and (3) responses to the audit items for each standard in the Report of Activities.

Be prepared to provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and 2005 hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

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 using the 2007 FHCF exposure data.

When the Professional Team arrives on-site, provide five (5) printed copies of all figures with scales for the *X* and *Y* axes labeled that are not so labeled in the submission. Label the figures with the same figure number as given in the submission. Also provide five (5) printed copies of Form V-3 and 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.

Be prepared to provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2006. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

If any changes have been made in any part of the model or the modeling process from the descriptions provided in the original 2010 submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and all revised Forms where any output of the Form changed.

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

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 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. Maps, databases, or data files relevant to the modeling organization's submission will be reviewed.

Trade Secret Information to be presented to the Professional Team:

- 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. (page 11)

Pre-Visit Letter

1. G-1, Disclosure 2, page 21: Describe the updates to the Vickery et al. (2009a) used in the current hurricane windfield model.

2. G-1, Disclosure 4, page 23: Clarify the references to (Vickery et al., 2009a) and (Vickery et al., 2009b) cited in the response to G-1, Disclosure 2, as they are not included in the References starting on page 255.

3. G-1, Disclosure 5, page 24: Provide the percentage difference in average annual zero deductible statewide loss costs and color-coded maps by county of the percentage difference for the two minor changes listed: (1) hurricane model updated to include data from the 2009 hurricane season, and (2) ZIP Codes updated to use the December 2009 data.

4. G-1, Disclosure 5.C, page 25: Explain the choice of default owner wood frame zero deductible loss costs as opposed to using the FHCF 2007 exposure data. Comment

on the magnitude of change in loss costs if another construction class, e.g., mobile home or masonry construction, had been used.

5. G-1, Disclosure 5.C, page 25: Be prepared to explain the situation with Suwannee County (increase >10%) in Figure 3.

Verified: YES

Professional Team Comments:

Covered items in the pre-visit letter. For example, sorted out the various references described in Disclosures 2 and 4. Updates with the 2009 season and ZIP Code data base covered in later sections. Suwannee County in Figure 3 and other potential anomalies resolved.

Discussed methodology for computing damage and loss to engineered and marginally engineered mid-rise and high-rise multi-unit residential buildings being the same as the methodology used for low-rise personal residential buildings.

Reviewed commercial residential variables corresponding to construction type, height, roof cover, opening protection, and era.

Reviewed combined effect of the Base Hurricane Storm Set update and the ZIP Code centroid update on windspeeds.

Discussed use of owner frame for illustrating changes in zero deductible loss costs by county for a better understanding of the model results. Reviewed similar results for owner masonry and mobile home structures.

Reviewed maps of changes in zero deductible loss costs for masonry, wood frame, and mobile homes.

G-2 Qualifications of Modeling Organization Personnel and Consultants

A. Model construction, testing, and evaluation shall be performed by modeling organization 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 modeling organization 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 modeling organization 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 modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

6. G-2, Disclosure 2.B, page 33: Response should include new personnel: consulting actuary Joseph Lebens and technical editor Lisa West. Provide the resumes of the new personnel working on the model or acceptability process who were not involved at the time of the previous Professional Team review. Discuss departures of personnel involved in the previous version of the model.

7. G-2, Disclosure 2.D, page 34: Consulting actuary Joseph Lebens should be available for at least two hours during the on-site review. While the full two hours may not be needed, Mr. Lebens should be prepared to discuss the steps taken to determine that the model meets each of the Actuarial Standards.

Verified: YES

Professional Team Comments:

Discussed personnel changes.

Reviewed resume for Lisa West, Division Administrator.

G-3 Risk Location

A. ZIP Codes used in the model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the model. ZIP Code information shall originate from the United States Postal Service.

B. ZIP Code centroids, when used in the model, shall be based on population data.

C. ZIP Code information purchased by the modeling organization shall be verified by the modeling organization for accuracy and appropriateness.

Audit

1. Provide geographic displays for all ZIP Codes.

2. Provide geographic comparisons of previous to current locations of ZIP Code centroids.

3. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.

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

Trade Secret Information to be presented to the Professional Team:

- Maps showing the ZIP Code boundaries and the associated centroids will be available to the Professional Team.

Pre-Visit Letter

8. G-3, page 37: Be prepared to review the updated ZIP Code centroids as has been done during previous on-site reviews.

Verified: YES

Professional Team Comments:

Reviewed updates to ZIP Code boundaries and centroids in conjunction with terrain/land use land cover database.

Reviewed plot of the combined effect of the hurricane model update to include data from the 2009 hurricane season and the ZIP Code centroid update on a 100-year return period 3-second peak gust wind in open terrain.

Reviewed specific examples of ZIP Code boundary and centroid changes in Gulf, Franklin, Hamilton, St. Lucie, Suwanee, and Polk counties. Reviewed the binder containing results for all counties.

Reviewed surface roughness calculation flowchart and the changes in surface roughness from the previous submission.

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

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, 2009*.

2. Describe all changes to the submission document since the previously accepted submission that might impact the final document submission.

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

4. Demonstrate that the submission has been reviewed by the signatories on Forms G-1 through G-6 for accuracy and completeness.

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

6. A flowchart defining the process for form creation will be reviewed.

7. Form G-7 will be reviewed.

Verified: YES

Professional Team Comments:

Interviewed Lisa West. Discussed the process for creating, editing, and reviewing the submission documentation.

Editorial items noted by the Professional Team during the on-site review 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.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 7, 2009 (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. Calibration and validation shall encompass the complete Base Hurricane Storm Set as well as any partitions.

Audit

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

2. Provide a flowchart illustrating how changes in the HURDAT database are used in the calculation of landfall distribution.

3. Reasoning and justification underlying any modification by the modeling organization to the Base Hurricane Storm Set will be reviewed.

4. Reasoning and justification underlying any short-term and long-term variations in annual hurricane frequencies incorporated in the model will be reviewed. (Trade Secret List item)

5. 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.

6. Form M-1 will be reviewed for consistency with Form S-1. Changes to the modeling organization's Base Hurricane Storm Set from the previously accepted submission will be reviewed.

7. 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

14. Form M-1, page 71: Be prepared to discuss the increase in modeled hurricane numbers for Regions A and B.

Verified: YES

Professional Team Comments:

The Base Hurricane Storm Set data is unchanged from HURDAT. No short-term or long-term variations in annual hurricane frequencies were incorporated in the model.

Reviewed flowchart of the process used to incorporate new data into the model.

HURDAT landfall distributions and intensities are used for stochastic occurrence rate and landfall intensity validation.

Discussed changes between Form M-1 in the current and previous submission.

Reviewed Form M-1. Consistency between Form M-1 and Form S-1 was confirmed. Discrepancies between integer storm counts are reasonable due to round-off.

M-2 Hurricane Parameters and Characteristics*

*(*Significant Revision)*

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 treatment of the inherent uncertainty in the conversion factor used to convert the modeled vortex winds to surface winds will be reviewed and compared with currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location within the windfield for a given hurricane intensity will be reviewed.

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

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

6. 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

9. M-2, page 52: Be prepared to discuss the model sensitivity to the choice of a fixed value of 0.8 for relative humidity.

10. M-2, page 54: Be prepared to discuss the choice of a fixed value of 1013 mb for far field pressure given the model sensitivity and uncertainty analysis in Form S-6.

Verified: YES

Professional Team Comments:

Reviewed appropriateness of external datasets and literature used.

Reviewed hurricane parameters used in the model. Distributions of hurricane parameters are unchanged from the previous submission.

Discussed choice of a fixed value of 0.8 for relative humidity. The fixed value is chosen due to lack of quality observations and is justified as reasonable based upon other studies.

Discussed the choice of a fixed value of 1013 for far field pressure. The fixed value was justified based upon previous studies and a sample of historical storms. Difficulties with retrieving quality data for storms were described, including the definition of "far field" distance in an individual event. Discussed existing data sources that could be useful for determining far field pressure for all storms.

Discussed values for far field pressure for recent, well-observed storms. Discussed variability among these values and the sources of these data for recent and older storms.

Reviewed treatment of uncertainty in the modeled to surface winds conversion factor. The modeled to surface winds conversion used is not in terms of a ratio, but relies on modeled boundary layer characteristics which are related to some characteristics of the hurricane being modeled. This methodology has recently been published in the scientific literature.

Reviewed the values of the spatially-varying coefficients for equations (1a) and (1b) for a grid encompassing Florida. Determined no dependence on longitude except for a location near the Yucatan.

Changes in the modeler-determined values of B and Rmax for a number of recent historical storms were identified in Form M-1. The underlying reasoning for these changes was described based upon new information in the scientific literature on adjustments to observed windspeeds; modeler adjustments to B and Rmax were designed to improve the simulated winds for these storms. Changes resulted in both decreased and increased windspeeds depending on the storm.

Reference to Vickery et al. (2008) was corrected to Vickery et al. (2009a).

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

B. Modeled hurricane landfall strike 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).

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. 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 modeling organization specific research performed to develop the functions used for simulating model variables or to develop databases.

5. Form S-3 will be reviewed for the probability distributions and data sources.

Pre-Visit Letter

11. M-3, Disclosure 1, page 59: Provide a summary list of all assumptions used in creating the hurricane characteristics databases.

Verified: YES

Professional Team Comments:

Base Hurricane Storm Set changes due to a HURDAT update are included in the storm starting point dataset. The stochastic storm tracks are rerun using these new starting points and all stochastic hurricanes satisfying either landfall or by-passing storm criteria are retained for development of loss costs in Florida. No partition by strike intervals is applied.

Reviewed the formulation for the occurrence rate distribution and the parameters used in conjunction with Form S-3. Reviewed the data underlying this formulation.

Reviewed data sources for other hurricane parameters. Rmax data were generally fit to the flight data; H*Wind analyses were used for Rmax in some recent storms.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

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 into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.

C. With respect to multi-story structures, the model windfield shall account for the effects of the vertical variation of winds if not accounted for in the vulnerability functions.

Audit

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

2. Provide any modeling organization-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, present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable windfield characteristics.

7. The effects of vertical variation of winds as used in the model where applicable will be reviewed. (Trade Secret List item)

8. Form M-2 will be reviewed.

Pre-Visit Letter

12. M-4, Disclosure 6, page 62: Be prepared to discuss the role of air-sea temperature difference in the model windfield.

Verified: YES

Professional Team Comments:

Organization-specific research for windfield functions is published in the open scientific literature. Databases are identified in the report. Friction is the only non-hurricane parameter affecting modeled surface winds.

Organization-specific research for roughness length was described. Reviewed and discussed the resultant spatial distributions of the roughness over Florida and translation of roughness to friction factor, including the high friction factors inland over the Everglades.

Reviewed detailed comparisons of the modeled windfield distribution and windspeeds with observations for Hurricanes Charley (2004), Katrina (2005) (over Florida) and Wilma (2005). Reviewed the new methodology (Masters et al. 2010) used for adjusting observed windspeeds based on instrument changes and local roughness. Discussed reasoning for this approach.

Reviewed asymmetry of modeled winds for these three storms. Discussed the method for simulating unusually high observed windspeeds to the left of storm track. This method is only used for historical storm simulations.

Discussed windspeed distributions in Form M-2. Modeled winds plotted in Form M-2 are calculated at ZIP Code centroids. Maximum winds in Form M-2 are also calculated at the ZIP Code centroids and plotted at the corresponding centroid location. New ZIP Code centroids incorporated in the current model were consistent with differences between the maps in Form M-2 in the current and previous submissions.

Discussed maximum modeled historical wind value for local terrain. Reviewed map of Hurricane Andrew (1992) windfield in open terrain and compared modeled winds with published maximum winds derived from observations.

Reviewed treatment of vertical variation of winds used in the model.

Comment on air-sea temperature difference (page 62) is left over from the old model; this parameter is no longer used. Page revised.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

A. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records and with current state-of-the-science.

B. The transition of winds from over-water to over-land within the model shall be consistent with current state-of-the-science.

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. Provide color-coded snapshot maps of roughness length and spatial distribution of windspeeds over-land and over-water for Hurricane Dennis (2005) and Hurricane Andrew (1992) at the closest time after landfall. (Trade Secret List item)

Pre-Visit Letter

13. M-5, Disclosure 4, page 67: Be prepared to discuss the impact of the landfall change in boundary layer height on modeled winds.

Verified: YES

Professional Team Comments:

Over-land decay rates used in the model are unchanged from the previous submission. Decay rate model is assigned at landfall location and that model used for as long as the storm remains over land.

Discussed comparison of the modeled weakening rate with observations. The windfield distribution for Hurricane Jeanne (2004) in Figure 9 was compared to observations. The winds were calculated using the stochastic model for B over land and the mean stochastic filling model appropriate to the landfall location.

Reviewed maps depicting windspeeds for Hurricanes Andrew (1992) and Dennis (2005) near landfall time. Discussed decreases in winds at the coast.

Discussed change in boundary layer depth at landfall. Methodology is documented in Vickery et al. (2009) and results in the surface wind reduction from the boundary layer mean. The model boundary layer depth is related to a measure of the storm intensity and size (inertial stability).

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 modeling organization's sensitivity analyses provide the information used in auditing this standard.

2. Justify the relationship between central pressure and radius of maximum winds.

3. Justify the variation of the asymmetry with the translation speed.

Pre-Visit Letter

15. Form M-3.A, page 78: Be prepared to provide the minimum radii values for the pressure band samples presently indicated with N/A.

16. Form M-3.A, page 78: Be prepared to explain why the entries in the table have changed relative to the previous submission.

Verified: YES

Professional Team Comments:

The table in Form M-3 has been revised to include values for all minima where they exist and to be consistent with the other exhibits in the form. Values in the previous submission were 5th and 95th percentiles and maximum and minimum values are given in the current submission.

Discussed large value for 40 mph winds at 990mb surface pressure and its impact on the loss costs.

Reviewed treatment of variation of asymmetry with translation speed.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

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 and associated uncertainties shall be theoretically sound.

C. Building height, construction type, and construction characteristics shall be used in the derivation and application of vulnerability functions.

D. In the derivation and application of vulnerability functions, assumptions concerning building code revisions and building code enforcement shall be justified.

E. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and time element coverages.

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

G. Vulnerability functions shall include damage due to hurricane hazards such as windspeed and wind pressure, water infiltration, and missile impact. Vulnerability functions shall not include explicit damage due to flood, storm surge, or wave action.

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 time element coverages 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.

5. Provide validation of the mean vulnerability functions and associated uncertainties.

6. 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).

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

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

9. Form V-1 will be reviewed.

Pre-Visit Letter

17. V-1, page 81: Describe the development of vulnerability functions for commercial residential properties added to the model this year.

18. V-1.B, page 81: In response to the new language in the standard, describe how the uncertainties associated with vulnerability functions were developed.

19. V-1.C, page 82: In response to the new language in the standard, describe how the model accounts for variation of windspeed with height of buildings in the development of vulnerability functions. Provide plots of vulnerability functions and their uncertainty for low-rise, mid-rise, and high-rise constructions.

20. V-1.D, page 82: Provide assumptions and justification regarding building code revisions and enforcement on vulnerability functions.

21. V-1, Disclosure 5, page 84: Be prepared to provide a complete list of categories of different vulnerability functions applicable to residential properties in Florida.

22. Form V-1, page 90: Account for differences between this year's submission and the previous submission.

Verified: YES

Professional Team Comments:

Discussed the methodology for development of vulnerability functions for commercial residential properties and confirmed that it is the same as the methodology for personal residential properties.

Reviewed commercial residential classification for various construction types, heights, roof covers, opening protection, and eras.

Reviewed 3-D graphical depictions of cumulative distribution functions of loss for various windspeeds impacting 2-story, 5-story and 8-story commercial residential engineered structures.

Reviewed mean loss damage curves for the four specific reference buildings in Form V-1.

Reviewed mean loss commercial residential damage curves for 2-story, 5-story, and 8-story steel and concrete building loss, contents loss, and time element loss.

Reviewed table of weights for various building class descriptions.

Discussed the uncertainties associated with the vulnerability functions.

Discussed how the model accounts for variation of windspeed with height of buildings in the development of the vulnerability functions. Reviewed plots of hurricane marine velocity profiles for the mean boundary layer windspeed ranges related to different building heights.

Reviewed graphical plots of cumulative distribution functions of loss for specific 2-story, 5-story, and 8-story buildings for 125 mph windspeed.

Reviewed assumptions regarding building code revisions in the development of the vulnerability functions. Discussed building code enforcement not being an explicit factor in the development of the vulnerability functions.

Reviewed listing of different vulnerability function categories for residential properties and their associated weights in the building stock.

Discussed differences in Form V-1 from the previous submission due to another building type added and minor changes in terrain roughness due to ZIP Code changes.

Reviewed versions of cumulative distribution function fits to simulated data for a specific building.

Discussed regional variations of damage functions. Reviewed damage functions for South and Central Florida.

Reviewed spreadsheet of variables and weights for construction characteristics by region and era. Discussed the underlying data used to develop the weighting.

Documentation reviewed:

- HURLOSS Risk Analysis Suite, Individual Building Damage Model, Part I, Volume II-B

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 (Trade Secret List item) 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

23. Form V-2, page 94: Be prepared to discuss this form and provide comments on the similarity of the mitigation impacts for the two construction classes.

Verified: YES

Professional Team Comments:

Discussed the variation of mitigation impact factors in Form V-2 being mostly driven by building envelope performance.

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

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.

3. The model will be reviewed to determine whether (if so, how) the model takes into account flood or hurricane storm surge.

Verified: YES

Professional Team Comments:

Verified that the model does not take into account flood or storm surge other than the effects of storm surge damage on the infrastructure.

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 modeling organization 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, (4) coinsurance, (5) contractual provisions, and (6) 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, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.

2. Provide the percentage of loss at or above which the model assumes a total loss.

Verified: YES

Professional Team Comments:

Discussed the commercial residential claims data used for validation.

Reviewed the details of the new computational approach used to model expected insured losses for commercial residential construction types and the effects of coinsurance on these loss costs.

Discussed the claim practices of insurers as they relate to the model and the impact of public adjusters on claims paid.

Reviewed new insurance company claims data.

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

*(*Significant Revision)*

A. Loss cost projections and probable maximum loss levels 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.

D. Loss cost projections and probable maximum loss levels shall be capable of being calculated at a geocode (latitude-longitude) level of resolution.

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.

Verified the model is capable of projecting loss costs and probable maximum loss levels at a geocode level of resolution.

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 personal and commercial residential coverages, 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.

Verified: YES

Professional Team Comments:

Reviewed the details of the new computational approach used to model expected insured losses.

Discussed the model revision to exclude effects of demand surge on contents.

Verified no change to the demand surge factors other than the contents change and no change to the application of demand surge to ground-up building and time element losses.

A-5 User Inputs

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

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 model inputs and assumptions will be reviewed to determine that the model output report appropriately discloses all modifications, adjustments, assumptions, and defaults used to produce the loss costs.

Pre-Visit Letter

24. A-5, Disclosures 2 & 3, pages 102-105: Provide evidence that Figure 20 and Figure 21 represent actual modeler input and model output reports. (Commission issue)

Verified: YES

Professional Team Comments:

Reviewed the sample modeler input and model output reports provided in the response to the deficiencies. Discussed the process used for input into the model and the standard outputs generated from each run of the model.

A-6 Logical Relationship to Risk*

*(*Significant Revision)*

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 time element) 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. The procedures used by the modeling organization to verify the 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.

Verified: YES

Professional Team Comments:

Discussed with Joe Lebens his review.

A-7 Deductibles, Policy Limits, and Coinsurance*

*(*Significant Revision)*

A. The methods used in the development of mathematical distributions to reflect the effects of deductibles, policy limits, and coinsurance 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.

D. The effects of coinsurance on commercial residential loss costs produced by the model shall be actuarially sound.

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.

1. To the extent that historical data are used to develop mathematical depictions of deductibles, policy limit, and coinsurance functions, demonstrate the goodness-of-fit of the data to fitted models.

2. Justify changes from the previously accepted submission in the relativities among corresponding deductible amounts for the same coverage.

Verified: YES

Professional Team Comments:

Reviewed details of the new computational approach used to model expected insured losses and its effects on coinsurance, policy limits, and deductibles.

Reviewed variables, equations, and computer code for calculating expected insured loss.

Reviewed validation testing of building loss cumulative distribution functions.

Discussed in detail the reasons for the change in methodology and the resulting change in insured losses.

A-8 Contents*

*(*Significant Revision)*

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. 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.

2. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Verified: YES

Professional Team Comments:

Reviewed the relationship of contents losses to building losses.

Reviewed the change to demand surge being inapplicable to contents.

A-9 Time Element Coverage*

*(*Significant Revision)*

A. The methods used in the development of time element coverage loss costs shall be actuarially sound.

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

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

D. Time element loss costs produced by the model shall appropriately consider time element claims arising from indirect loss.

Audit

1. Documentation and justification of the following will be reviewed:
   a. The method of derivation and data on which the time element vulnerability functions are based;
   b. Validation data specifically applicable to time element coverages;
   c. Assumptions regarding the coding of time element losses by insurers;
   d. The effects of demand surge on time element for Hurricane Andrew (1992) and the 2004 and 2005 hurricane seasons;
   e. Assumptions regarding the variability of time element losses by size of property;
   f. Statewide application of time element coverage assumptions;
   g. Assumptions regarding time element coverage 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 time element costs.

2. To the extent that historical data are used to develop mathematical depictions of time element functions, demonstrate the goodness-of-fit of the data to fitted models.

Verified: YES

Professional Team Comments:

Verified no changes made in the model relative to time element losses from the previous submission.

A-10 Output Ranges*

*(*Significant Revision)*

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. personal 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. The sample output range report produced by the model for commercial residential loss costs will be reviewed.

2. Justify all changes from the previously accepted submission using the 2007 Florida Hurricane Catastrophe Fund aggregate personal residential 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

25. A-10, Disclosure 2, pages 113-121: Be prepared to provide a detailed description of the changes in the output ranges from those in the previous submission, with particular attention to the following areas:
    a. Zero Deductible Contents – all categories
    b. Zero Deductible Additional Living Expense – all categories
    c. Masonry Renters – all columns
    d. All positive changes from previous submission with indicated loss cost increases
    e. Nassau County – all columns – Owners categories
    f. Jefferson County – all columns – Owners categories
    g. Bradford County – all columns – Owners categories
    h. Washington County – all columns – Owners categories

Verified: YES

Professional Team Comments:

Reviewed impact of the model changes on each loss cost category.

Reviewed and resolved several anomalies in the output ranges.

Discussed the rationale for changes in the output ranges being partially attributed to the changes in modeling of the FHCF 2007 exposure data from the previous submission.

A-11 Probable Maximum Loss*

*(*Significant Revision)*

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. (Trade Secret List item)

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

Verified: YES

Professional Team Comments:

Verified no change in the previously accepted methodology for producing probable maximum loss estimates.

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 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 modeling organization characterization of uncertainty for windspeed, damage estimates, annual loss, and loss costs will be reviewed.

Pre-Visit Letter

26. S-1, Disclosure 6, page 218: The central pressure historical values in Figure 51 are uniformly higher than the model mean curve. Prepare analogous figures for the other regions of Florida and overall for the state.

Verified: YES

Professional Team Comments:

Reviewed the change in negative binomial parameters in the 2009 storm set update.

Reviewed plots of goodness-of-fit tests of modeled and historical hurricane landfall pressures for Texas, Louisiana, Mississippi and Alabama, North Carolina, Georgia and South Carolina, Virginia and Maryland and New Jersey, New York and New England, the Gulf Coast, the Florida Coast, the Atlantic Coast, the entire U.S. Coast, and regions of Northwest, Southwest, Southeast, and Northeast Florida.

Discussed use of the re-sampling technique described in James and Mason (2005).

Reviewed the formulation for the occurrence rate distribution. Reviewed data underlying this formulation. A revised Form S-3 was provided.

Documentation reviewed:

- HURLOSS Risk Analysis Suite, LIFESIM-I: Hurricane Model, Volume I-A

S-2 Sensitivity Analysis for Model Output*

*(*Significant Revision due to requirement of Form S-6)*

The modeling organization 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 modeling organization'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.

Pre-Visit Letter

27. Form S-6, pages 239-240: Be prepared to explain the peak mean loss costs at approximately 20 miles inland with coastal losses around 50% of the peak.

Verified: YES

Professional Team Comments:

Reviewed ESDU based friction factor maps for southwest Florida. Discussed the lower terrain roughness resulting in the larger losses at some locations inland. High inland losses would occur in the Everglades where there is very smooth terrain.

Reviewed the results from Form S-6. Loss cost summary results were reproduced by the Professional Team. Windspeed results were reviewed from both a statistical and meteorological perspective.

S-3 Uncertainty Analysis for Model Output*

*(*Significant Revision due to requirement of Form S-6)*

The modeling organization 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 modeling organization'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.

Verified: YES

Professional Team Comments:

Reviewed the results from Form S-6. Windspeed results were reviewed from both a statistical and meteorological perspective.

Discussed the benefits of uncertainty analyses for directing future work and the contribution to the uncertainty by far field pressure for category 1 storms.

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:

Confirmed that 300,000 simulated years meets the standard.

S-5 Replication of Known Hurricane Losses*

*(*Significant Revision)*

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 modeling organization. This standard applies separately to personal residential and, to the extent data are available, to commercial residential. 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. Commercial residential
      5. Condominiums
      6. Structures only
      7. 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 comparison of modeled and actual total losses by company for Hurricanes Andrew (1992), Charley, Frances, Ivan and Jeanne (2004), and Wilma (2005).

Reviewed comparison of modeled and actual total losses as a function of peak gust windspeed in open terrain for Hurricane Charley (2004).

Reviewed the commercial residential validation comparisons provided in response to the deficiencies.

Discussed changes in the validation comparison for Hurricane Andrew (1992) from the previous submission.

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 for consistency with Standard G-1, Disclosure 5.

2. Justify the following:
   a. Meteorological parameters,
   b. The effect of by-passing hurricanes,
   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 Form S-5.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

A. The modeling organization 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 submission shall be consistently documented and dated.

C. The modeling organization shall maintain (1) a table of all changes in the model from the previously accepted 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. Modeling organization 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 and is maintained consistently with 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

28. C-1.C, page 245: Be prepared to relate the table of contents with the response to Standard G-1, Disclosure 5 by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Discussed process for documentation of code. Verified that documentation is created separately from the source code.

Reviewed table of all changes in the model from the previously accepted submission.

Discussed improvements needed in the details and organization of documentation in general.

Reviewed the HurLoss Risk Analysis Suite, Primary Document Binder.

Reviewed HurLoss Binder 1-A for hurricane track and intensity model documentation.

C-2 Requirements*

*(*Significant Revision)*

The modeling organization shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component. Requirements shall be updated whenever changes are made to the model.

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.

Pre-Visit Letter

29. C-2, page 246: Be prepared to provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed requirements documentation for the model changes.

Reviewed requirements documentation for commercial residential.

Reviewed requirements documentation for the revised computational approach to the insured loss calculation, including:

- Computing ground-up losses by coverage
- Applying demand surge to ground-up losses by coverage
- Applying deductibles, limits, and coinsurance as per Standard A-7
- Enumerating possible future enhancements.

Reviewed requirements for hurricane track and intensity models. Determined that recent publications document the methods implemented in the code.

C-3 Model Architecture and Component Design

The modeling organization 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 the flowchart for developing terrain roughness by ZIP Code.

Reviewed the flowchart for incorporating HURDAT changes in the calculation of landfall distribution.

Reviewed schema definitions for commercial residential vulnerability functions in the HurLoss building class description spreadsheets.

Reviewed updated component design for hurricane track and intensity models.

C-4 Implementation

A. The modeling organization shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.

B. The modeling organization 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 modeling organization 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 modeling organization 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 Fortran code used to calculate expected insured loss.

Reviewed table of code variables used in the function for insured loss created during the audit.

Reviewed Fortran code used to update the model to include data from the 2009 hurricane season.

Reviewed the Fortran coding standards for HurLoss documentation. Verified no change in the coding guidelines.

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

Reviewed the code implementation for the Polya cumulative distribution function.

Reviewed comment headers for the insured loss calculation functions.

Reviewed revised implementation documentation for hurricane track and intensity models.

C-5 Verification

A. General

For each component, the modeling organization 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 modeling organization personnel other than the original component developers.

B. Component Testing

1. The modeling organization 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 modeling organization shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.

2. The modeling organization 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 modeling organization 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.

4. Flowcharts defining the processes used for manual and automatic verification will be reviewed.

5. The response to Disclosure 1 will be reviewed.

Pre-Visit Letter

30. C-5, page 250: Be prepared to provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed verification method for insured losses and probable maximum loss calculations.

Discussed process followed for code verification and testing for continuity independent of the Fortran source code.

Reviewed spreadsheet of cumulative distribution function methodology verification.

Reviewed flowchart of verification process.

Reviewed the response to disclosure 1 and discussed random number generators are not used in the code.

Reviewed the bounds-checking method to handling exceptions.

Reviewed the testing software approach used by the modeler.

C-6 Model Maintenance and Revision

A. The modeling organization 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 modeling organization shall use tracking software to identify all errors, as well as modifications to code, data, and documentation.

D. The modeling organization 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, 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

31. C-6.D, page 252: Be prepared to provide the model version history leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed the policy for model revision. Verified no change from the previous submission.

Verified no change in the tracking software from the previous submission.

C-7 Security

The modeling organization 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 submission with regard to security and backup procedures.

Discussed the modeler's confidence that there have been no security breaches to the model software.