Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2007 Standards

Risk Management Solutions, Inc.

On-Site Review
April 16-18, 2008

On April 16-18, 2008, the Professional Team visited on-site at Risk Management Solutions, Inc. (RMS) in Newark, California to review RiskLink version 6.0b. The following individuals participated in the review.

RMS

Enrica Bellone, Ph.D., Lead Catastrophe Risk Modeler
Auguste Boissonnade, Ph.D., Vice President, Probabilistic Modeling Science & Technology Research
Kay Cleary, FCAS, MAAA, Actuary, Regulatory Practice
Katie Coughlin, Ph.D., Senior Catastrophe Risk Modeler
Michael Drayton, Ph.D., Consultant
Bikramjit Singh Goraya, Manager, Software Development
Guy C. Morrow, S.E., Vice President, Model Development
Matthew Nielsen, Product Manager, Americas Region
Rohit Prakash Mehta, Senior Engineer, Model Development and Implementation
John Reiter, Vice President, Software Core Products Development
Beth Stamann, Documentation Specialist
Joel Taylor, Analyst, Public Policy Group
Christine Wallinger, Senior Analyst Public Policy
Robert Ward, Director, Public Policy
Michael Young, M.E.Sc., P.E., Senior Director of Claims & Exposure Development
Christine Ziehmann, Ph.D., Director, Product Management Americas Models

Professional Team

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

The review began with introductions and an overview of the audit process. RMS followed with a presentation on the changes in the 2008 model (RiskLink version 6.0b) relevant to the personal residential lines of business and the impact of the changes on loss costs.

- Updated event rates to account for hurricane activity from 2006 and 2007
- Updated postal codes from vintage 2005 to vintage 2007
- Use of condo-unit owner occupancy for condo owner policy rather than multi-family dwelling
- Changes to secondary modifiers

The Professional Team reviewed the following corrections to be included in the revised submission provided to the Commission prior to the May 20-22, 2008 meetings.

1. Page 16, G-1.2 – sentence referencing November 1, 2005 Report of Activities removed
2. Page 21, G-1.2 – clarification of 10-minute sustained winds converted to 1-minute winds, correction of sign error in equation 2, consistency of variables in equations, and reference to H*Wind

3. Page 23, G-1.2 – clarification of number of primary characteristics listed in Table 1
4. Page 35, G-1.4 – the word relevant removed before references
5. Page 38, G-1.5 and page 86, G-3.1 – clarification of dates of postal code update
6. Page 38, G-1.6 – updated response for substantive changes in the submission
7. Page 41, G-2.2A – Beth Stamann added
8. Page 79, G-2.2B – Narvdeshwar Pandey and Beth Stamann added
9. Page 83, G-2.3A – revised relative to independent peer reviews
10. Page 108, M-2.1 – clarification on central pressure and forward speed
11. Page 114, M-3.A – second paragraph in response to Standard clarified
12. Page 114, M-3.2 – correct statement relative to central pressure and forward speed
13. Page 155, Form V-1 – reference to 2006 Report of Activities corrected
14. Page 322, Form A-8 – legend for Figure 29 corrected
15. Pages 336-337, S-1.7 – Figures 39 and 40 captions clarified on use of independent data in these comparisons

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the March 21, 2008 meeting. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Acceptability Process, Notification of Readiness for Review
   Hard copy of the letter to the Commission, supplemental information, or the Model Submission Checklist not provided in submission documentation.

2. Standard G-1, Disclosure 2 (page 25)
   Last sentence in second paragraph states, “Selected references are provided in G-1.4.” A comprehensive, rather than selected, list of references is required.

3. Standard G-1, Disclosure 5 (page 38)
   The new modifier option introduced this year as given on page 149 under “IBHS Fortified Program” is not included.

4. Form M-3.C (pages 134-135)
   Box plot not provided as required.

5. Form A-3 (pages 187-189)
   Hurricanes Rita and Wilma missing from Form in hard copy submission.

6. Standard C-4 (page 369)
   No response provided to Part F of Standard.

7. Standard C-6, Disclosure 2 (page 377)
   No response provided to Disclosure.

8. Form S-4 (pages 360-361)
   Part A, item A, current year values not provided in descriptive text.
   Part A, item C, confirm that the 95% confidence interval test applies to the current year values.
   Responses to items B, C, and D not provided for Part A and Part B.

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

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

Be prepared to provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2002 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2002 FHCF exposure data. Be prepared to discuss changes in loss costs from the use of the 2007 FHCF exposure data from the loss costs produced using the 2002 FHCF exposure data.

When the Professional Team arrives on-site, a copy of Form V-3 must be available. Also 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.

Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since 2005 (three years prior). Be prepared to describe any processes used to amend or validate the model that incorporates this data.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

1. The main intent of the audit is to determine the capabilities of the model and to assess its implementation for purposes of Florida projected loss costs. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.

2. 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 (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 1, page 15 – Describe any changes (other than changes pertaining particularly to medium or short term calculations) that have been performed on other RMS models subsequent to that which is incorporated in the development and validation of RiskLink version 6.0b.

2. G-1, Disclosure 2, page 16 – Identify any deviations of the RMS storm database due to the analyses performed in conjunction with Charles Neumann and others.

3. G-1, Disclosure 2, page 16 – Confirm that the RMS storm database is consistent with the Commission's "2005 Report of Activities."

4. G-1, Disclosure 2, page 20 – Clarify whether any SST-dependent scaling is used in deriving the pressure histories (whether on pressure or pressure deficit).

5. G-1, Disclosure 2, page 20 – Confirm that centroids weighting is based on population.

6. G-1, Disclosure 2, page 21 – Confirm that one-minute sustained 10-meter windspeeds are used to determine intensity at landfall or by-pass.

7. G-1, Disclosure 2, page 22 – Discuss the direct use of the log law with respect to articles over most of the last decade describing internal jets in the hurricane boundary layer.

8. G-1, Disclosure 2, page 22 – Describe any recent analyses performed to determine that the current roughness factors are appropriate, including the use of updated ASTER. Provide the most recent analysis performed on the ASTER data, and the results of such analyses.

9. G-1, Disclosure 2, page 23 – Confirm that the storm surge and flood modules of the model are not enabled in RiskLink version 6.0b.

10. G-1, Disclosure 2, page 23 – Confirm the number of primary building characteristics.

11. G-1, Disclosure 2, page 25 – Last sentence of second paragraph refers to "selected references." Provide a comprehensive list as required in G-1, Disclosure 4.

12. G-1, Disclosure 4, page 35 – Discuss use of section "Relevant References."

13. G-1, Disclosure 5, page 38 – Verify which vintage postal data is used in light of page 86, "The USPS vintage of the ZIP Code data used in the submitted model is August 2005."

14. G-1, Disclosure 5, page 38 – Describe the ramifications of item 3 in the itemized description.

Verified: YES

Professional Team Comments:

Discussed the different versions of RiskLink available for use by clients. RiskLink 7.0 was released in the Spring/Summer of 2007. Modeler stated all updates in RiskLink 7.0 were previously incorporated in RiskLink 6.0b except for medium term rates.

Verified sea surface temperatures are not used to scale pressure in the model.

Verified centroid weighting is based on population for Commission Standards.

Verified one-minute sustained 10-meter windspeeds are used in the windfield calculation.

Discussed use of the log-law and modeling only at the 10-meter height rather than the whole profile.

Discussed analyses performed to determine current roughness factors. Confirmed no updates to the roughness factors in the last two years. Discussed use of ASTER imagery.

Verified storm surge and flood were not included in producing loss costs results in the submission.

Discussed the number of primary building characteristics given in Table 1 on page 24. Reviewed the modeled relationship between condo-owner and homeowner association damage ratios. Discussed the basis for the change in using condo-unit owner occupancy for condo owner policies rather than multi-family dwelling. Reviewed the impact of the change on loss costs.

G-2 Qualifications of Modeler Personnel and Consultants

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

B. The model or any modifications to an accepted model shall be reviewed by either modeler personnel or consultants in the following professional disciplines: structural/wind engineering (licensed Professional Engineer), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall be signatories on Forms G-1 through G-6 as applicable and shall abide by the standards of professional conduct if adopted by their profession.

Audit

1. The professional vitae of modeler personnel and consultants responsible for the current model and information on their predecessors if different than current personnel will be reviewed. Background information on individuals providing testimonial letters in the submission shall be provided.

2. Forms G-1, G-2, G-3, G-4, G-5, G-6, and all independent peer reviews of the model 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

15. G-2, Disclosure 2.A, pages 41-44 – Explain the "N.A." entries in Tables 2 and 3.

16. G-2, Disclosure 2.B, page 79 – Provide a curriculum vita or resume for each of the employees listed.

17. G-2, Disclosure 3.A, pages 82-84 – Discuss the relevance of the independent peer reviews to the current model.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Li Cao, M.A. Economics (Ph.D. program), Georgetown University; B.A. Culture Economics/International Trade, Shanghai Jiao Tong University
- Sandra Cruze, Ph.D., Business, Golden Gate University; B.A. Mathematics, San Francisco State University
- Alpana Das, M.A. Mathematical Statistics, University of Delhi, India; B.A. Statistics, Lady Shri Ram College, University of Delhi, India; Post Graduate diploma Marketing Management, All India Management Association, Delhi, India
- Amit Kaura, M.S. Computer Science, California State University; M.S. Applied Mathematics, Indian Institute of Technology, Roorkee
- Eric Laszlo, M.S. Mathematics, California State Polytechnic; B.S. Mathematics, California State Polytechnic
- Roberta Mantovani, Ph.D. Physics (Dynamic Meteorology), Bologna University, Italy; University Degree in Physics (Dynamic Meteorology), University of Rome "Tor Vergata", Italy
- Roopa Nair, M.S. Statistics, Hindu College, University of Delhi, India; B.S. Statistics, P.G.D.A.V. College, University of Delhi, India
- Nervdeshwar Pandey, M.Tech Future Studies and Planning, Devi Ahilya Vishwavidhyalaya, Indore; M.S. Mathematics, D.D.U. University Gorakhpur
- Rahul Patasariya, B.Tech Civil Engineering, ITT Roorkee
- Priya Rajendran, B.S. Computer Science, Bharathiyar University, India
- Rhoderick Rivera, Computer Engineering, University of Illinois
- Afsal P. Seyed, B.E. Computer Science & Engineering, Karnatak University, India; B.S. Mathematics, Calicut University, India
- Fei Sha, Ph.D. Economics, University of Kansas; B.A. Economics, Tianjin University of Finance & Economics
- Jayant Srivastava, B.S. Physics, Delhi University, India, Post Graduate Diploma in Computer Applications, India
- Beth Stamann, Michigan State University
- Joel Taylor, B.S. Mathematics, Bradley University
- Ji Zhang, M.S. Computer Science, California State University East Bay; B.A. Mathematics, Xiamen Unversity, Xiamen China
- Christine Ziehmann, Ph.D. Meteorology, Free University Berlin, Germany

Verified that no former employees left for violation of professional ethical standards.

Discussed the relevance of the independent peer reviews to the current model.

G-3 Risk Location

A. ZIP Codes used in the model shall be updated at least every 24 months using information originating from the United States Postal Service. The United States Postal Service issue date of the updated information shall be reasonable.

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

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

Audit

1. Provide geographic displays for all ZIP Codes. The location of specific centroids will be reviewed.

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

Pre-Visit Letter

18. G-3, Disclosure 2, page 86 – Provide detailed description with examples of process described to validate ZIP Codes used in the development or validation of the model.

Verified: YES

Professional Team Comments:

Clarified that the ZIP Code data source is dated October 2007.

Reviewed the process for validating ZIP Codes on data provided by vendor.

Reviewed changes in the current ZIP Code database release. Reviewed examples of ZIP Code centroid movements in Florida via maps generated during on-site audit.

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 and loss costs). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model would not meet this Standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.

2. Describe all changes in the model since the previous submission that might impact the independence of the model components.

Verified: YES

Professional Team Comments:

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

G-5 Editorial Compliance*

*(*New Standard)*

All documents 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, 2007*.

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 error free regarding the inclusion of extraneous data or materials. Form G-7 will be reviewed.

Verified: YES

Professional Team Comments:

Discussed with Beth Stamann her process for editorial review. Reviewed schematic of the process for producing the RMS 2007 Standards & Disclosures.

Discussed the interaction of this Standard with Computer Standards regarding previous errors in the submission documents and their revisions for this year's submission.

Reviewed the new quality assurance procedures implemented to mitigate errors discovered during audit, during which submission Forms were found to be in error.

Reviewed the product development process and timeline components of their evolving quality assurance procedures. Documentation reviewed:

RMS Process Introduction v.2.0

Reviewed their incident reporting mechanism, RiskBugs.

Verified the new documenting procedure designed to include last date modified and modification history on all documentation provided to the Professional Team during the audit. Reviewed revised documents with revision history table:

Test Plan for USHU Model Implementation Geocoding/Hazard/Vulnerability
FCHLPM CATFUND EDM generation for RL6.0b
Model Management Market Requirements Document Summary – RiskLink 6.0b
Response to Pre-Visit Letter related to Risk Location, #5 and #18

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.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 1, 2007 (or later), HURDAT as of June 1, 2005 plus the 2005 and 2006 seasons, or HURDAT as of June 1, 2006 plus the 2006 season. 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. 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

19. M-1.B, page 103 – Confirm that the response given with application to Florida also applies to adjacent states.

Verified: YES

Professional Team Comments:

Verified no differential weighting or partitions were used in developing the historical landfall frequency by category in Florida and adjacent states.

Discussed the development of the historical storm database with contributions from Charles J. Neumann contributed to the HURDAT reanalysis project. Reviewed storm track examples of Neumann's edits and HURDAT 2008.

M-2 Hurricane Parameters and Characteristics*

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

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, the spatial and time variant windfields, and conversion factors, shall be based on information documented by 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

20. M-2, Disclosure 1, page 106 – Provide the data and methodology underlying the development of the pressure profile parameter and the gradient to surface reduction factors from the 1998-2001 H*Wind database.

21. M-2, Disclosure 1, page 107 – Provide the methodology used for updating the central pressure and forward speed databases through 2007. Comment on related Disclosures S-2.3 and S-3.3.

22. M-2, Disclosure 2, page 107 – Clarify air density dependencies.

23. M-2, Disclosure 5, page 108 – Describe the process by which a spatially varying function is derived for conversion of gradient winds to surface winds. Relate this to the application of the parameters a, b, and c used in equation (2) on page 21.

24. M-2, Disclosure 6, pages 108-109 – Describe the application of roughness factors to determine surface winds with differing temporal averaging times.

25. M-2, Disclosure 11, page 113 – Describe the determination of over-water roughness factors.

Verified: YES

Professional Team Comments:

Discussed development of the pressure profile parameter and the gradient to surface reduction factors from H*Wind database. Reviewed the windfield model and pressure profile coefficient (Holland B parameter) based on Georgiou's gradient model.

Discussed the development of central pressure and forward speed using HURDAT 1900-2000 and validation using HURDAT as of January 8, 2008 with updates for the 2007 hurricane season from NHC storm reports as given in Figures 39 and 40.

Reviewed sensitivity analyses on air density dependencies. The air density approximation takes into account the decrease in density with pressure. Reviewed very weak sensitivity to air density.

Reviewed the application of roughness factors to determine surface winds with differing temporal averaging times. Gust factor is a function of turbulence intensity and averaging time. Turbulence intensity factor is a function of height and roughness.

Reviewed the methodology to calculate the roughness factors. A constant roughness length is used over water.

Reviewed the development of the gradient to surface wind parameters from H*Wind.

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 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.

Verified: YES

Professional Team Comments:

Verified method for importance sampling of the stochastic storm track.

Verified time periods used in development of central pressure and translation speed distributions.

M-4 Hurricane Windfield Structure*

*(*New Standard)*

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, Hurricane Katrina, and Hurricane Wilma.

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

26. M-4, Disclosure 1, page 116 – Provide examples of wind radii corresponding to five different (Vmax, Rmax) combinations for both the largest and smallest shape parameter used for the stochastic storm windfield, demonstrating consistency of wind radii with Form M-3.

27. M-4, Disclosure 6, page 118 – Provide information on the land use land cover database used for adjacent states, including application of the ASTER satellite imagery.

28. M-4, Disclosure 8, Figures 8-10, pages 119-120 – Provide the methodology used in preparing the RMS model figures.

29. M-4, Disclosure 9, page 121 – Provide radial profiles of the azimuthally averaged rotational winds derived from the model compared to observations for Hurricanes Charley, Katrina, and Wilma.

Verified: YES

Professional Team Comments:

Addressed each audit item and each pre-visit letter item in depth.

Reviewed wind profiles for five Rmax and Vmax combinations. Discussed the ranges of damaging wind radii with respect to Form M-3.

Reviewed ASTER imagery used for application of the land use land cover data for adjacent states. Determined that land use land cover updates using ASTER imagery were reasonable.

Reviewed the methodology for comparing spatial distribution and intensities of surface windfields for the RMS modeled windfield and the H*Wind windfield.

Reviewed radial profile comparisons to H*Wind observations for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005). Discussed the locations of the H*Wind and RMS profiles derived for Hurricane Wilma (2005) relative to landfall time and the impact on the derived profiles.

Reviewed expanded Table 22 (page 331) with additional information for Hurricane Charley (2004), Hurricane Wilma (2005), and Hurricane Katrina (2005) modeled wind errors. Discussed range of windspeeds implied for 40% errors for intense storms. Reviewed scatter plots for Hurricane Charley (2004), Hurricane Wilma (2005), and Hurricane Katrina (2005), modeled versus station observations, discussing sources of discrepancies. Performed same review for Hurricane Charley (2004), Hurricane Wilma (2005), and Hurricane Katrina (2005) modeled winds versus H*Wind.

Summary tables and plots revealed no biases.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

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.

Pre-Visit Letter

30. M-5.A, page 122 – Confirm that this methodology is unchanged since the 2003 Cook review.
31. M-5.A, page 123 – Define the windspeed reduction factor plotted in Figure 11 with reference to equations provided in the submission.

32. M-5.B, page 123 – Provide RMS analyses of Hurricanes Charley, Katrina, and Wilma confirming that the RiskLink version 6.0b model is consistent with historical records for these storms. Describe the methodology used in deriving these figures.

Verified: YES

Professional Team Comments:

Reviewed definition for windspeed reduction factor.

Reviewed the windspeed reduction factor plotted in Figure 11 on page 123 confirming inland extent.

Reviewed comparison of normalized windspeeds for landfalling hurricanes for historical storms using HURDAT winds and the stochastic storm set winds.

Reviewed comparison of observed winds versus modeled winds for Hurricane Charley (2004) and Hurricane Jeanne (2004).

Reviewed decay rates for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005) compared to the range of stochastic decay rates.

Reviewed maps depicting the modeled filling rate for Hurricane Charley (2004) and Hurricane Jeanne (2004). Reviewed spatially-distributed station observation comparisons with modeled windfields for slow and fast filling rate extremes.

Reviewed table of wind observations at several stations comparing the observed winds to modeled winds with a slow filling rate and a fast filling rate.

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

33. Form M-3, page 135 – Discuss the paucity of Category 4 storms in Figure 17 with reference to Form M-1.

Verified: YES

Professional Team Comments:

Reviewed the results provided in Form M-3 and Figure 17. Discussed the discontinuity in the density of Category 4 storms (920 – 944 mb) due to the importance sampling approach.

Discussed the method used for completing Form M-3.

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, or historical data.

B. The method of derivation of the vulnerability functions shall be theoretically sound.

C. Any modification factors/functions to the vulnerability functions or structural characteristics and their corresponding effects shall be clearly defined and be theoretically sound.

D. Construction type and construction characteristics shall be used in the derivation and application of vulnerability functions.

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

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. Form V-1 will be reviewed.

Pre-Visit Letter

34. V-1.B, page 137 – Provide an example of calibration of component-based damage functions using historical claims data.

35. V-1, Disclosure 2, page 141 – Provide "summaries of exposure and loss data sets" referred to in response.

36. V-1, Disclosure 2, page 142 – Provide details of the use of 2004 data in Table 9 calibrations.

40. Form V-1, page 154 – Verify that one-minute sustained 10-meter windspeeds were used to complete the Form.

41. Form V-1, Part B, page 154 – Discuss the small differences in "Estimated Damage/Subject Exposure" values for Mobile Home versus both the Wood Frame and Masonry values.

Information to be presented to the Professional Team: (PVL #35 above)

- V-1.2, page 141 – Summaries of exposure and loss data sets and their use in the development of vulnerability functions will be available for on-site review by the Professional Team.

Verified: YES

Professional Team Comments:

Verified vulnerability functions have not been updated since 2006.

Reviewed the process for development, validating, and updating the vulnerability functions.

Discussed ALE correlation to structure and content damage.

Reviewed multi-family dwelling (condo) owner and association vulnerability functions development.

Verified that the base vulnerability functions are free of demand surge.

In the course of reviewing Form V-1, modeler revealed that last year's final submission contained an incorrect Form V-1. A revised Form V-1 was provided on-site with the following corrections.

	RMS Final Submission under 2006 Standards – Old	RMS Final Submission under 2006 Standards Corrected - New
Part A		
Wind Speed (mph)	Estimated Damage/ Subject Exposure	Estimated Damage/ Subject Exposure
41 – 50	0.1%	0.1%
51 – 60	0.3%	0.2%
61 – 70	1.2%	0.8%
71 – 80	2.6%	1.9%
81 – 90	5.2%	4.0%
91 – 100	10.1%	7.3%
101 – 110	17.8%	12.9%
111 – 120	35.9%	30.6%
121 – 130	48.0%	43.3%
131 – 140	68.7%	65.3%
141 – 150	88.3%	86.4%
151 – 160	96.2%	95.5%
161 – 170	97.2%	97.2%
Part B		
Construction Type	Estimated Damage/ Subject Exposure	Estimated Damage/ Subject Exposure
Wood Frame	8.4%	8.4%
Masonry	8.0%	8.0%
Mobile Home	10.6%	9.5%

Reviewed the process for completing Form V-1. Verified one-minute sustained windspeeds were used. Discussed differences in Form V-1 from previous submission. Discussed the error in completing Form V-1 for last year. The revised Form V-1 for last year was reviewed.

Discussed the reasons for differences in Form V-1 for mobile home versus both wood frame and masonry.

Verified that mobile home vulnerability functions were developed using extensive 2004 data with further validation from 2005 data.

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 total 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

37. V-2, page 148 – Provide all data and processes used to implement the changes to secondary modifiers referenced in G-1.5, item #4.

38. V-2, Disclosure 2, page 149 – Discuss "IBHS Fortified Program" and provide all data along with processes used by which modifiers that are applied in the model.

39. V-2, Disclosure 3, page 152 – Provide a detailed description of the adjustment to the base vulnerability curves for mitigation.

42. Form V-2, page 157 – Discuss the many changes for the 135 and 160 mph values from previous submission while many values for 60, 85, and 110 mph remain the same.

Verified: YES

Professional Team Comments:

Reviewed the data and process used for the changes to secondary modifiers:
- Roof Anchor – toe-nail option
- Roof Sheathing Attachment – 6d nails, unknown nailing schedule option
- Foundation – engineered option

Reviewed the corresponding code for secondary modifiers and their joint effects.

Discussed the process for adjusting the base vulnerability functions for secondary modifiers.

Discussed the IBHS Fortified Program modifier option.

Discussed the changes in Form V-2 attributed to the changes in the secondary modifiers which only involved higher windspeeds.

Reviewed results provided in Form V-2 and Form V-3 (Trade Secret List). Reviewed spreadsheets used to generate Forms V-2 and V-3. Verified with actual calculations that Form V-2 entries were consistent with the values in Form V-3.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs

Modeled loss costs shall reflect all 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.

Verified: YES

Professional Team Comments:

Verified no change in the model definition of landfalling hurricanes and by-passing storms.

A-2 Underwriting Assumptions

A. When used in the modeling process or for verification purposes, adjustments, edits, inclusions, or deletions to insurance company input data used by the modeler shall be based upon accepted actuarial, underwriting, and statistical procedures.

B. For loss cost estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) claim payment practices, and (4) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be 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." Provide the methods used to delineate among the insurer claim practices in the use of historical claims data to verify model outputs.

Verified: YES

Professional Team Comments:

Verified no change in methodology for reviewing claims payment practices of insurance companies.

Previously reviewed communication with insurance companies regarding claims data.

A-3 Loss Cost Projections

A. Loss cost projections produced by hurricane loss projection models shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

B. Loss cost projections shall not make a prospective provision for economic inflation.

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 no change in the method for producing loss costs based on insurance company claims data.

A-4 Demand Surge

A. Demand surge shall be included in the model's calculation of loss costs 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 determine the effects of demand surge.

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

Pre-Visit Letter

43. A-4, page 163 – Provide analyses performed using data from 2004 to validate the demand surge calculations in the model.

Verified: YES

Professional Team Comments:

Reviewed the "Loss Amplification" model, its development, and the process for determining the maximum factor to be applied in the calculation. Reviewed the three major components of the "Loss Amplification" model presented in the submission.

1) Economic Demand Surge Model – based on understanding of economic drivers of increases in labor costs and building materials as demand exceeds supply.

2) Claims Inflation – based on difficulties in fully adjusting claims following a catastrophic event.

3) Super CAT Loss Amplification – based on loss expansion due to secondary or tertiary events such as evacuation effects, containment failures (flooding from failures of dams, levees, landslides, etc.), or systemic economic downturn (impact of the catastrophe on the economy) in metropolitan areas.

Reviewed plots of loss amplification factors.

Discussed use of 2004 claims data in development of the "Loss Amplification" model. Modeler determined that cumulative 2004 storms demand surge was greater than Hurricane Andrew (1992) demand surge.

Total demand surge in 2005 was shown to be nearly 50% of demand surge in 2004.

Verified no changes were made in the "Loss Amplification" model since the previous submission.

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.

Verified: YES

Professional Team Comments:

Discussed the process for reviewing new data received from insurance companies. Reviewed how the 2007 FHCF exposure data was processed. Reviewed series of checks on data to convert them to a form compatible with the RMS model.

Verified appropriate ingestion of FHCF exposure data for selected categories.

Reviewed documentation on the procedure followed for updating the 2007 FHCF exposure data:

FCHLPM Catfund EDM generation for RL6.0b

Verified no change in the methodology from the previous submission.

A-6 Logical Relationship to Risk

A. Loss costs shall not exhibit an illogical relation to risk, nor shall loss costs exhibit a significant change when the underlying risk does not change significantly.

B. Loss costs produced by the model shall be positive and non-zero for all valid Florida ZIP Codes.

C. Loss costs cannot increase as 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

44. A-6, Disclosure 2, page 171 – Discuss the inflexion point near MDR 10% in Figure 21 (b).

45. Form A-2, pages 184-186 – Provide supplementary information for ZIP Codes in and around Franklin County.

46. Form A-2, Figure 26, page 186 – Provide supplementary information for Pinellas County ZIP Codes that have large loss costs and are adjacent to neighboring protective ZIP Codes having lower loss costs.

47. Form A-4, Table 16, pages 190-196 – Verify total for Hurricane Andrew versus what is given in Form A-3.

48. Form A-5, Part A, pages 199-200 – Explain totals provided in Table 17.

49. Form A-5, Part A, page 200 – Discuss the changes in return periods depicted in Figure 28 with reference to responses for G-1.5 and A-10.4.

Verified: YES

Professional Team Comments:

In the course of reviewing Form A-3, modeler reported that they discovered an error in Form A-3 that was provided to the Commission in last year's final submission. A revised Form A-3 was provided on-site with the following corrections.

Date	Year	Name	Total Insured Losses ($) RMS Final Submission under 2006 Standards – Old	Total Insured Losses ($) RMS Final Submission under 2006 Standards Corrected – New
8/25/2004	2004	Frances	28,367,720.69	27,244,185.49
9/2/2004	2004	Ivan	9,308,105.12	8,997,069.52
9/13/2004	2004	Jeanne	33,890,409.12	35,069,287.53
7/4/2005	2005	Dennis	6,206,735.26	6,723,168.67
8/23/2005	2005	Katrina	8,526,340.82	8,197,870.32

For Form A-3, corrections were noted since the original submission on March 17, 2008. Total insured losses have been revised for Hurricane Andrew (1992), Hurricane Erin (1995), and Hurricane Georges (1998) as follows:

Date	Year	Name	Total Insured Losses ($) RMS Original Submission under 2007 Standards – Old	Total Insured Losses ($) RMS Corrected Form provided with responses to Deficiencies - New
8/16/1992	1992	Andrew	25,630,543,733.62	21,689,463,104.46
7/31/1995	1995	Erin	595,119,910.50	686,799,403.25
9/15/1998	1998	Georges	406,280,417.54	394,040,208.10

Hurricane Rita (2005) and Hurricane Wilma (2005) were missing in the printed and pdf Form of the original submission, but appeared in the associated Excel version of the Form.

Discussed the results provided in Figure 21 (b), masonry.

Reviewed maps of ZIP Code loss costs for Franklin and surrounding counties.

Reviewed maps of ZIP Code loss costs for Pinellas and surrounding counties.

Reviewed results provided in Form A-4 compared with Hurricane Andrew (1992) value given in Form A-3.

Reviewed calculations used to produce results provided in Form A-5, Table 17 totals.

Reviewed plot comparing the current model return times to the previous submission return times based on the 2002 FHCF exposure.

Reviewed procedures for producing all A and S Forms (see Standard G-5).

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.

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

2. 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.

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:

Verified no change in handling contents losses.

Verified that 2004 claims data was used by modeler to validate contents loss cost calculation methods.

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;
    e. Assumptions regarding the variability of ALE by size of property;
    f. Statewide application of ALE assumptions;
    g. Assumptions regarding ALE for mobile homes, tenants, and condo unit owners exposure;
    h. The methods used to incorporate the estimated time required to repair or replace the property;
    i. The methodology and available validation for determining the extent of infrastructure damage and its effect on ALE costs.

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

3. Justify the differences in the relationship of structure and ALE loss costs from those previously found acceptable.

Verified: YES

Professional Team Comments:

Verified no change in the process and calculations used to develop ALE loss costs.

Verified that 2004 claims data was used by modeler to validate ALE loss cost calculation methods.

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-6A, A-6B, A-7, and A-8 will be reviewed.

2. The modeler will be required to justify all changes from the prior submission using the 2002 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.

Verified: YES

Professional Team Comments:

Reviewed impact on loss costs for each update to the model given in Standard G-1, Disclosure 5.

Reviewed the effects of the change in exposure by using the FHCF 2007 exposure on total AAL, owners frame, masonry, renters, and condo owners.

Reviewed effects of revision of definition of condo owners classification.

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 and S-2 will be reviewed.

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

Pre-Visit Letter

50. S-1, Disclosure 3, page 331 – Describe the results of tests performed to validate windspeeds for recent storms. Describe the results of tests performed to validate windspeeds since the storm asymmetry applied through coefficients (a, b, c) has been included.

52. Form S-1, page 353 – Justify changes in modeled probabilities in light of the addition of the 2006 and 2007 seasons.

Verified: YES

Professional Team Comments:

In the course of reviewing Form S-1, modeler revealed that last year's final submission contained an incorrect Form S-1. A revised Form S-1 was provided on-site with the following corrections.

Number of Hurricanes Per Year	Modeled Probability RMS Final Submission under 2006 Standards – Old	Modeled Probability RMS Final Submission under 2006 Standards Corrected - New
0	0.5970	0.5561
1	0.3079	0.3263
2	0.0794	0.0958
3	0.0137	0.0187
4	0.0018	0.0027
5	0.0002	0.0003

Verified that current Form S-1 is consistent with both this revised Form and two additional years (2006 and 2007) of no storms.

Discussed results of tests performed to validate windspeeds for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005).

Reviewed scatter plots of open terrain wind comparisons of wind swaths of H*Wind observed winds with modeled winds for Hurricane Charley (2004) and Hurricane Wilma (2005).

Reviewed methodology for calculating results provided in Form S-1. Reviewed comparison of Form S-1 results to previous year's submission.

Reviewed Table 22 (page 331) in further detail.

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-5 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Changes to model did not necessitate update to Form S-5. No change from the previous submission.

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-5 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Changes to model did not necessitate update to Form S-5. No change from the previous submission.

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:

Discussed the importance sampling process for adjusting landfall frequency rates by category and landfall location to achieve convergence on the average annual loss by county.

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:
      i. Personal versus commercial
      ii. Residential structures
      iii. Mobile homes
      iv. Condominiums
      v. Structures only
      vi. Contents only,
   i. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.

2. The following documentation will be reviewed:
   a. Publicly available documentation referenced in the submission,
   b. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
   c. An analysis that identifies and explains anomalies observed in the validation data,
   d. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

3. The confidence intervals used to gauge the comparison between historical and modeled losses will be reviewed.

4. Form S-3 will be reviewed.

5. The results of one hurricane event for more than one insurance company and the results from one insurance company for more than one hurricane event will be reviewed to the extent data are available.

Pre-Visit Letter

51. S-5, Disclosure 1, page 350 – Discuss the sources of difference between the RMS estimate compared to the OIR and PCS estimates for Hurricanes Dennis, Katrina, and Ivan given in Table 24.

~~53. Form S-3, pages 355-359 – What is driving the change in Loss/Exposure values from last year's submission?~~

Verified: YES

Professional Team Comments:

Discussed the results provided in Table 24 on page 350 and the reasons for the differences between the RMS estimate compared to the OIR and PCS estimates.

Mix of modeled versus actual losses across hurricanes and insurance companies demonstrated no apparent bias.

Deviations in Table 24 were verified to be plausible.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-4 will be reviewed.

2. Justify the following:
   a. Meteorological parameters,
   b. The effect of by-passing storms,
   c. The effect of actual hurricanes that had two landfalls impacting Florida,
   d. The departures, if any, from the 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.

Pre-Visit Letter

54. Form S-4, pages 360-361 – The results in Form A-3 appear to be inconsistent with Form S-4.

55. Form S-4, pages 360-361 – Discuss the changes in loss costs differences between Tables 26 and 27 with reference to the LULC dataset used in the model.

Verified: YES

Professional Team Comments:

The inconsistency between Forms A-3 and S-4 were resolved in the corrected Form S-4 provided in response to the deficiencies.

Discussed differences in loss costs between Tables 26 and 27 in Form S-4 in relation to the land use land cover dataset.

Confirmed that the revised values in Form S-4 are consistent with other parts of the submission. Multiple values were modified in Form S-4 since the February submission.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

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

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

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

Audit

1. The primary document binder, in either electronic or physical form, and its maintenance process will be reviewed. The binder shall contain fully documented sections for each Computer Standard.

2. All documentation shall be easily accessible from a central location.

3. Complete user documentation, including all recent updates, will be reviewed.

4. Modeler personnel, or their designated proxies, responsible for each aspect of the software (i.e., user interface, quality assurance, engineering, actuarial, 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. A table for each item listed in Standard G-1, Disclosures 5 and 6 will be reviewed. The table 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, Disclosures 5 and 6 through all Computer Standards.

Information to be presented to the Professional Team:

- C-1.A, page 363 – A Computer Standards primary document binder in electronic form has been prepared by RMS and is available for on-site review by the Professional Team.
- C-1.B, page 363 – Appropriate personnel for software, data preparation and validation, as well as internal users of the software, will be available to the Professional Team when the Computer Standards are being audited.

Verified: YES

Professional Team Comments:

Reviewed the Primary Document Binder, organized electronically using a file hierarchy.

Reviewed FCHLPM CATFUND EDM Generation for RiskLink 6.0b document.

Reviewed table required by Standard C-1, Audit 6 for affected components for each items listed in Standard G-1, Disclosure 5.

Verified the new documenting procedure designed to include last date modified and modification history on all documentation provided to the Professional Team during the audit.

Reviewed revised documents with revision history table:

Test Plan for USHU Model Implementation Geocoding/Hazard/Vulnerability
FCHLPM CATFUND EDM generation for RL6.0b
Model Management Market Requirements Document Summary – RiskLink 6.0b
Response to Pre-Visit Letter related to Risk Location, #5 and #18

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.

Information to be presented to the Professional Team:

- C-2, page 365 – This documentation, which is described in the response to disclosure C-2, is available for on-site review by the Professional Team.
- C-2.1, pages 365-366 – Requirements documentation available for on-site review by the Professional Team includes:
  - RiskLink System Administration Guide
  - RiskLink DLM User Guide
  - Coding Standards
  - Market Requirements Documents
  - Functional Specifications
  - Project Management Documents
  - Visual SourceSafe 6.0
  - Information Technology Security Documents
  - Quality Assurance Test Plans

Verified: YES

Professional Team Comments:

Reviewed Model Management Market Requirement Document Summary – RiskLink 6.0b.

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.

Information to be presented to the Professional Team:

- C-3, page 366 – This internal model architecture and component design documentation, as well as the developers or modelers responsible for each component, are available for on-site review by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the flowchart pertaining to handling of secondary modifiers.

Reviewed a flowchart used for handling ZIP Codes.

Reviewed the multiple steps used to create Form A-3.

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, Disclosures 5 and 6:

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.

Information to be presented to the Professional Team:

- C-4.C, page 368 – Detailed data flow diagrams of the model components will be available for review by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the parameter table specifying minima and maxima on the secondary modifier calculations.

Reviewed the implementation for V_G and V_S/V_G in equations (1) and (2) on page 21 in the submission.

Verified that incorrect sign (now corrected) in equation (2) within the submission did not appear in code.

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.

Pre-Visit Letter

56. C-5.A, page 370 – Provide a statement to the effect that verification tests have been performed by modeler personnel other than the original component developers *for each* component.

Verified: YES

Professional Team Comments:

Reviewed documentation on the test plan for completing Forms in the submission.
QA Test Plan for forms A1-A8 & S1-S4 (FCHLPM Submission) dated 3/17/2008

Reviewed charts, maps, and figures used as verification of items in Standard G-1, Disclosure 5.

Verified the use of verification procedures used by testing for extreme values in the code.

Reviewed development and refinement of testing procedures for new modules or stand-alone codes.

Reviewed the new quality assurance procedures implemented to mitigate errors discovered during audit, during which submission Forms were found to be in error.

Reviewed the product development process and timeline as part of their evolving quality assurance procedures. Documentation reviewed:
RMS Process Introduction v.2.0

Reviewed the modeler's incident reporting mechanism, RiskBugs, which included code, data, and submission incidents.

C-6 Model Maintenance and Revision

A. The modeler shall maintain a clearly written policy for model revision, including verification and validation of revised components, databases, and data files.

B. A revision to any portion of the model that results in a change in any Florida residential hurricane loss cost shall result in a new model version number.

C. The modeler shall use tracking software to identify all errors, as well as modifications to code, data, and documentation.

Audit

1. All policies and procedures used to maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, the modeler 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.

Information to be presented to the Professional Team:

- C-6.1, page 377 – These systems and procedures are available for detailed review by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the flowchart-specified policy of model revision.

Reviewed the rules and procedures employed for the model version numbers.

Verified the use of tracking software.

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 that recently hired employees receive information technology training on security.

Verified that password sharing is prohibited.

Reviewed the written policy and methods used to ensure the security of code, data, and documentation.

Verified that termination of employee user accounts occurs immediately when the employee leaves the company.