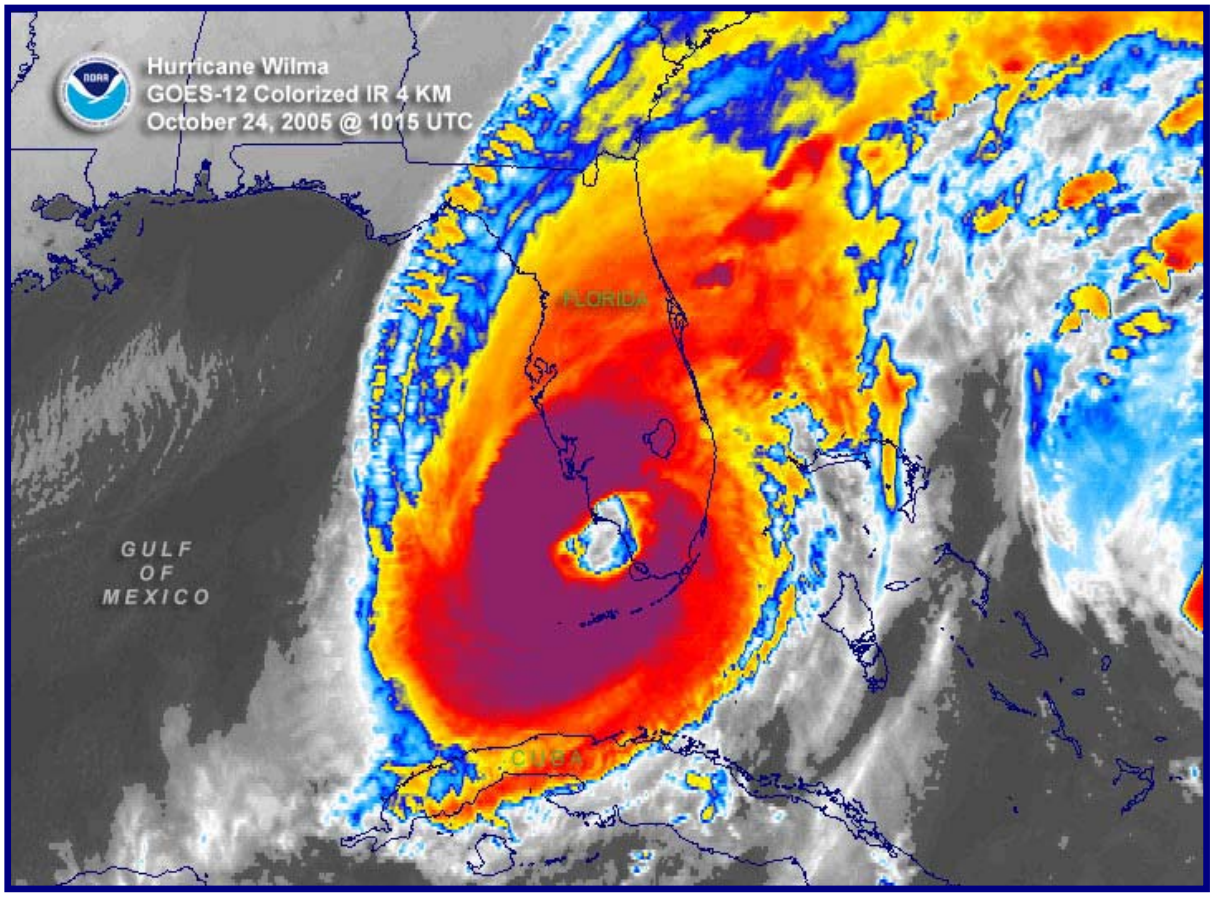
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2006 Standards

Risk Management Solutions, Inc.

On-Site Review
April 23 – 25, 2007

Additional Verification Review
June 20, 2007

On April 23-25, 2007, the Professional Team visited on-site at Risk Management Solutions, Inc. (RMS) in Newark, California to review RiskLink version 6.0a. The following individuals participated in the review.

RMS

Richard R. Anderson, FCAS, MAAA, Chief Actuary, Actuarial and Financial Modeling
Enrica Bellone, Ph.D., Senior Statistician
Auguste Boissonnade, Ph.D., Vice President, Model Development, Weather Risk
Kay Cleary, FCAS, MAAA, Actuary, Regulatory Practice
Katie Coughlin, Senior Catastrophe Risk Modeler
Tom Foster, Technical Analyst
Bikramjit Singh Goraya, Manager, Software Development
Steve Jewson, Ph.D., Vice President, Climate Hazard Model Development
Manuel Lonfat, Ph.D., Senior Research Meteorologist
Chuck Menum, Ph.D., Lead Vulnerability Engineer
Guy C. Morrow, S.E., Vice President, Model Development
Rohit Prakash Mehta, Senior Engineer, Model Development and Implementation
Matthew Nielsen, Senior Analyst, Model Management
Adam O'Shay, Ph.D., Senior Tropical Cyclone Modeler, Climate Hazard and Model Development
Rajesh K. Singh, Ph.D., P.E., Senior Director, Model Development Operations
John Reiter, Vice President, Software Core Products Development
Mitch Sattler, Vice President, Public Policy Model Management
Christine Wallinger, Regulatory Practice Analyst
Michael Young, M.E.Sc., P.E., Lead Wind Vulnerability Engineer, Product Development

Professional Team

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

The review began with introductions and an overview of the audit process. RMS followed with a presentation on the changes in the 2007 model (RiskLink version 6.0a) relevant to the personal residential lines of business.

- New hurricane event rates in the Atlantic basin that explicitly represent risk over a medium-term five-year timeframe.
- New Post-event Loss Amplification (PLA) or the contribution of demand surge to total losses.
- New vulnerability functions for single-family residential occupancies that vary with square footage of property.
- Changes to secondary modifiers including 1) new modifier for the Fortified…for Safer Living™ program for new wood and masonry residential single-family buildings, 2) adjustments to the foundation modifier for wood frame buildings, 3) new modifier for carport/screen enclosures for manufactured homes, and 4) change in software to make

secondary modifiers inactive when any of the primary variables of construction, occupancy, number of stories, and year built are not present.

The Professional Team expressed concerns relative to the elicitation process used by the modeler in its development of the medium range hurricane forecasting model. Following discussions with the modeler, the Professional Team concluded that we were unable to verify Standards G-2, G-4, M-1, M-4, A-8, A-9, A-10, and S-1. The modeler was presented with the options available to them as described in the *Report of Activities*.

Reviewed the following corrections to be included in the revised submission provided to the Commission prior to the May 8-11, 2007 meetings in addition to the editorial corrections noted in the Professional Team pre-visit letter.

1. Page 22, G-1.2, revised to round values provided for square footage bands in Table 1.
2. Pages 24-26, G-1.3, revised to update the model flowchart for the new 5-year perspective.
3. Pages 27-35, G-1.4, revised to include additional references.
4. Page 35, G-1.5, revised to elaborate on the response.
5. Pages 39-72, G-2.2.A and B, revised to include two additional new employees.
6. Page 93, M-1, revised to reword "matches" to "employs."
7. Page 93, M-1.1, revised for clarification on data sets.
8. Page 95, M-2.1, revised to expand on the description of historical data sets used for each of the storm characteristics.
9. Page 101, M-3.1, revised to remove the qualifier "(per disclosure M-1.2)."
10. Page 111, Form M-1, revised to correct historical counts for Cat 5 storms in Southeast Florida and to correct the Note provided under Table 9.
11. Page 126, V-1.5, revised to round values provided for square footage bands in Table 12.
12. Page 244, S-1.1, revised to correct p-values given for the statistical tests under landfall frequency.
13. Page 245, S-1.2, revised to clarify that the landfall rates were developed using HURDAT 1900-2006.
14. Pages 247-249, S-1.5, Figures 32-34 corrected for RiskLink version 6.0a rather than version 5.1a.
15. Page 252, S-1.6, revised to clarify x-axis label in Figure 37.
16. Pages 254-256, S-2.1, Figures 38-40 corrected for RiskLink version 6.0a rather than version 5.1a.
17. Page 269, Form S-2, revised to correct probability of exceedance for the top event.
18. Pages 270-274, Form S-3, revised to include demand surge.

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Additional Verification Review – June 20, 2007

RMS submitted revisions to the original February 28, 2007 model submission under the 2006 Standards on June 4, 2007. The Professional Team completed the additional verification review on June 20, 2007 in Tallahassee. As noted in the subsequent sections, RMS has reverted to the long term event set. **All Standards are now verified**.

The following individuals participated in the additional verification review:

RMS

Richard R. Anderson, FCAS, MAAA, Chief Actuary, Actuarial and Financial Modeling (via phone)
Enrica Bellone, Ph.D., Senior Statistician
Kay Cleary, FCAS, MAAA, Actuary, Regulatory Practice
Guy C. Morrow, S.E., Vice President, Model Development
Matthew Nielsen, Senior Analyst, Model Management
Adam O'Shay, Ph.D., Senior Tropical Cyclone Modeler, Climate Hazard and Model Development
John Reiter, Vice President, Software Core Products Development
Mitch Sattler, Vice President, Public Policy Model Management
Christine Wallinger, Regulatory Practice Analyst
Michael Young, M.E.Sc., P.E., Lead Wind Vulnerability Engineer, Product Development

Professional Team and SBA Staff

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

The additional verification review began with an overview of the review process. The Professional Team indicated it would be focusing on the revisions submitted on and subsequent to June 4, 2007.

RMS provided an overview of the changes to the model since the initial verification review on April 23-25, 2007 that included:

- incorporating the hazard files from RiskLink 5.1a into RiskLink 6.0a,
- updating event information related to long term rates, and
- incorporating Loss Amplification (demand surge) factors for long term event set.

The Professional Team identified additional track changes that required additional page corrections.

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the March 13, 2007 meeting. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Standard G-1, Disclosure 2 (page 18)
   Response is unclear.

2. Standard G-1, Disclosure 2 (page 19)
   Modeler references Lonfat et al. (2007) that is unpublished.

3. Standard G-1, Disclosure 4 (pages 27-35)
   Simpson (1981) reference cited on page 14 is not included.

4. Standard G-1, Disclosure 5 (pages 35-36)
   Non-responsive as a detailed description of the new hurricane event rates is not provided.

5. Standard G-2, Disclosure 1.F (page 39)
   Response is unclear.

6. Standard G-3.B (page 78)
   Response is unclear.

7. Standard M-1, Disclosure 2 (page 93)
   Response is incomplete.

8. Standard M-4.B (page 103)
   Response is unclear.

9. Standard M-5, Disclosure 6 (page 109)
   Response is the same as response provided under Disclosure 7 and is non-responsive to Disclosure 6.

10. Form M-2.A (page 113)
    Response is non-responsive.

11. Form V-1.B, One Hypothetical Event (pages 133-134)
    Modeler did not confirm that the structures used in completing the form are identical to those in the table provided.

12. Standard A-5, Disclosure 4 (page 145)
    Response provided in second bullet is unclear.

13. Form A-5, Distribution of Hurricanes by Size of Loss (pages 178-179)
    Total row in Table 19 is incorrect and differs from the electronic version provided.

Additional changed pages were submitted with the response to deficiencies.

Pre-Visit Letter

The following editorial corrections are noted. The Professional Team will need to review the corrected pages before completing the on-site review.

1. "Model Submission Checklist" missing from hard copies.
2. "Supplemental Information" missing from hard copies.
3. Page 9, List of Figures missing Figures 41 & 42.

Provide for the Professional Team's review, all insurance company claims data received since the review by the Professional Team in 2004 (three years prior). Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2004 (three years prior). Be prepared to describe any processes used to amend or validate the model that incorporates this data.

The Professional Team reviewed the editorial corrections noted above during the course of the audit. Corrections will be included in the revised submission provided to the Commission prior to the May 8-11, 2007 meetings.

Modeler confirmed that no new insurance company claims data have been reviewed since the prior on-site review.

Modeler confirmed that no new engineering survey data have been collected since the prior on-site review.

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

Additional Verification Review Comments

The Professional Team reviewed additional editorial corrections noted during the audit on June 20, 2007. Corrections will be included in the revised submission provided to the Commission at the June 21-22, 2007 meetings.

GENERAL STANDARDS – Mark Johnson, Leader

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

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

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 2, page 18 – Elaborate on the methods and implementation of the new Step 8 "Adjust landfall frequencies". Development of methodology through to code implementation will be reviewed.

2. G-1, Disclosure 2, page 18 – Provide studies and analyses used in the determination that a five year time period is more appropriate than other specific time periods.

3. G-1, Disclosure 2, page 18 – Discuss addition of stochastic storms affecting Florida in the hurricane model.

4. G-1, Disclosure 2, page 20 – Referring to paragraph, "The database itself is created…," justify the timeliness of the land use land cover database used.

5. G-1, Disclosure 2, page 22 – Discuss, as shown in Table 1, the addition of a Square Footage classification along with all backup information used to define this classification.

6. G-1, Disclosure 3, pages 25-26 – The flowchart is the same as last year. How is the new 5-year time horizon incorporated into the model? What is the historical storm database referred to here: (i) time period covered; (ii) adjacent states included?

7. G-1, Disclosure 5, page 36 – Referring to paragraph, "The software has been configured…," discuss how the configuration of the software has been changed to inactivate the secondary modifiers when any of the primary variables are not present.

Verified: YES

Professional Team Comments:

Response to G-1.2, page 22, revised to round values provided for square footage bands in Table 1.

Response to G-1.3, pages 24-26, revised to update the model flowchart for the new 5-year perspective.

Response to G-1.4, pages 27-35, revised to include additional references.

Response to G-1.5, page 36, revised to elaborate on the response.

Reviewed the methodology underlying the new hurricane event rates in the Atlantic basin using the RMS medium-term perspective. Discussed chi-square statistical tests on the changes in Florida activity rates across the periods of 1926-1969, 1970-1994, and 1995-2006 identified by Goldenberg et al. (2001).

Reviewed the medium-term perspective methodology including:

- Development of a suite of statistical models to estimate expected activity in the Atlantic and for U.S. landfalls
- Elicitation of expert opinions on what best represents future levels of activity
- Study of regionalization using RMS definition of storm types, including the change in distribution of storms by type and intensity and among storms of a same type (storm types are modeler classification)
- Implementation of results by storm types and intensity.

Reviewed the RMS five different types of storms (by genesis) and examples of historical storms by type.

Reviewed the elicitation process for the expert opinions obtained. Reviewed the selection process for the experts and the experts involved. Reviewed list of peer-reviewed published papers over the last 10 years by experts on the relevant topic.

Reviewed documentation provided to the experts prior to the elicitation and a portion of the material presented at the elicitation workshop. Reviewed the questions asked and the weighted results from the experts.

Reviewed the twenty classes of statistical models for prediction of US landfalling hurricane numbers that were developed and presented to the experts at the elicitation.

Reviewed the use of historical data in the medium-term methodology:

- Relies on all data across the 1900 to 2006 period for assessing U.S. landfalls
- Statistical models presented at the elicitation relied on data up to 2005
- Statistical models used to estimate the basin activity include only data after 1950 which was deemed reasonable by the expert panel
- No adjustments were made to HURDAT records.

Reviewed the regionalization approach implemented including:

- Study of the distribution of storms by type in periods of heightened activity
- Study of hurricane activity of storms approaching the U.S. coastline, as a function of storm intensity to determine whether all storms of one type are affected the same way
- Findings from the studies combined to generate a distribution across storm types and intensity
- Implementation conducted on the increment in hurricane frequencies.

Reviewed distribution of U.S. landfalling Category 1-5 storms by type for the long term historical record (1900-2005) and for periods of heightened activity of 1995-2005 historical data and subset of 1900-2005 historical data adding one standard deviation.

Reviewed comparison of medium term and historical distribution of storms by type in Florida of RiskLink version 5.1a and RiskLink version 6.0a.

Reviewed main development region (MDR) sea surface temperature (SST) time series with predictions based on an 8-year moving average and a 22-year trend analysis. Reviewed comparison between RMS SST trends and other sources of trend information.

In the context of the 5-year time frame, reviewed the possibility that the 2006 uneventful year and a possible 2007 uneventful year and how this scenario compares to the possibilities presented to the experts in the elicitation process.

Reviewed the 90% / 10% mixed baseline model and its implementation in the importance sampling used for the stochastic storm generation.

Reviewed the Flowchart on pages 25 of the submission with reference to the warm period subset of years.

Reviewed the square footage addition to the vulnerability functions and a validation test that was corrected while we were on-site.

Reviewed in the computer code the adjustment to landfall frequencies to incorporate the short and long term variations in annual storm frequencies.

Verified that the software for secondary modifiers has been set to inactive for exposures lacking information on primary modifiers.

Documentation reviewed:

- Changes in the Rates of North Atlantic Major Hurricane Activity During the 20th Century, James B. Elsner, Thomas Jagger, and Xu-Feng Niu, Geophysical Research Letters, Vol. 27, No. 12, Pages 1743-1746, June 15, 2000.
- Tropical Cyclone Reconstructions from Documentary Records: Examples for South Carolina, United States, Cary J. Mock, Hurricanes and Typhoons Past, Present, and Future, Richard J. Murnane and Kam-Biu Liu, Editors, Columbia University Press, Pages 121 – 148, 2004.

- Predicting Hurricane Numbers from Sea Surface Temperature: Closed Form Expressions for the Mean, Variance and Standard Error of the Number of Hurricanes, Stephen Jewson, January 15, 2007, http:www.stephenjewson.com, arXiv:physics/0701167v1
- Year-ahead Prediction of Hurricane Season Sea Surface Temperature in the Tropical Atlantic, Jonathan Meagher, Stephen Jewson, June 21, 2006, http:www.stephenjewson.com, arXiv:physics/0606185v1
- Five Year Prediction of Sea Surface Temperature in the Tropical Atlantic: A Comparison of Simple Statistical Methods, Thomas Laepple, Stephen Jewson, Jonathan Meagher, Adam O'Shay, Jeremy Penzer, January 16, 2007, http:www:stephenjewson.com, arXiv:physics/0701162v1
- Predicting Landfalling Hurricane Numbers from Sea Surface Temperature: Theoretical Comparisons of Direct and Indirect Approaches, Stephen Jewson, Thomas Laepple, Kechi Nzerem, Jeremy Penzer, January 29, 2007, http:www.stephenjewson.com, arXiv:physics/0701176v2
- Predicting Basin and Landfalling Hurricane Numbers from Sea Surface Temperature, Stephen Jewson, Roman Binter, Shree Khare, Kechi Nzerem, Adam O'Shay, January 29, 2007, arXiv:physics/0701170v2

Additional Verification Review Comments

Reviewed the revised material submitted on and subsequent to June 4, 2007.

Investigated storm set used for model updates. Verified that the number of storms in the storm set used is correct.

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

8. G-2, Disclosure 2, page 72 – Provide resumes for the new employees listed.

9. G-2, Disclosure 3, pages 74-75 – Explain the relevance of the referenced peer reviews to the meteorology component of the current submission.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

It is the opinion of the Professional Team that the substantial modifications from RiskLink 5.1a to RiskLink 6.0a have not been demonstrated to be in compliance with Actuarial Standards of Practice #25 from a credibility standpoint, especially as it relates

to potential bias and stability of results. Hence, G-2 could not be verified by the Professional Team while on site.

Reviewed Actuarial Standard of Practice #25, Section 3, Analysis of Issues and Recommended Practices, "The actuary should select credibility procedures that do the following:

1) produce results that are reasonable in the professional judgment of the actuary,
2) do not tend to bias the results in any material way,
3) are practical to implement, and
4) give consideration to the need to balance responsiveness and stability."

The Professional Team noted concerns, including the following relative to the elicitation process.

- An apparent bias towards high end choice of the categories from the questions asked of the participants and the wording of the questions
- Concern relative to the size of the group of participants, the selection process for the participants, and the applicability of the expert elicitation process in meteorological science
- The statistical models not explicitly addressing the possibility (for example) of ENSO or QBO occurring within the 5-years
- The apparent incongruity between data sets for hurricane frequency and data sets for all other hurricane characteristics
- While the experts dealt with overall basin wide frequencies, RMS took it further to regionalization of storm type frequency.

Modeler personnel presented responses to each of these items. The Professional Team was unable to verify Standard G-2 and presented the modeler with the options provided on pages 40-41 of the *Report of Activities*.

Responses to G-2.2.A and B will be revised to include two additional new employees, Katie Coughlin and Manabu Masuda.

Reviewed the following resumes of new personnel involved with the model:

- Shobana C. Azariah, Rational TeamTest fundamentals for functional and performance testing, IBM Rational; Advanced functional testing with Rational Robot; Masters in Public Administration, University of Madras, Madras, India
- Kay Cleary, BA Northwestern University
- Kimberly Court, B.E.Sc, Civil/Structural Engineering, University of Western Ontario
- Joshua K. Darr, M.S. Atmospheric Sciences, State University of New York at Albany, Concentration: Mid-latitude synoptic/dynamic weather and tropical meteorology, Thesis: *A Quantitative Assessment of Extratropical Transition in the Atlantic Basin*; B.S. Atmospheric Sciences, Cornell University, Ithaca, NY
- Thomas M. Foster, M.S. Geological Sciences, University of Michigan, Specialized in Climate Modeling, Paleoclimate, Climate Feedbacks, and Climate Change, "Modeling El Nino and changes in tropical teleconnections since the Last Glacial"; B.S. Meteorology, Penn State University

- Stephen Jewson, Ph.D., Physics, Oxford University; M.A. Mathematics, Cambridge University; B.A. Mathematics, Cambridge Unversity
- Shree Prakash Khare, Ph.D. in Atmospheric and Oceanic Sciences, Princeton University, Thesis: *Observing system design for optimal prediction of geophysical fluid flows – analysis of ensemble methods*; BSc Physics, University of British Columbia
- Manuel Lonfat, Ph.D. Meteorology, Rosenstiel School of Marine and Atmospheric Science, University of Miami; M.S. Physics, Solid State Physics Group – Physics Department, University of Hawaii; M.S. Engineering, Department of Physics, Swiss Federal Institute of Technology in Lausanne
- Manabu Masuda, M.S. Civil Engineering, Stanford University; M.E. Architectural Engineering, Kobe University, Hyogo, Japan, Thesis: *Elasto-Plastic Cyclic Bending Deformation and Fatigue Fracture Behavior of Steel-Encased Reinforced Concrete Beam to Column Joints*; B.E. Architectural Engineering
- Kechi Nzerem, M.S. Applied Statistics, Birkbeck College, University of London; B.A. Mathematics, King's College, Cambridge University
- Mitch Sattler, M.S. Statistics, Louisiana State University; B.A. Business Administration, University of Arkansas
- Christine Wallinger, B.S. Mathematics, Bradley University, Peoria, Illinois
- Yen-Tin Yang, M.S. Management Science & Engineering, Stanford University; Certificate, Computer Information Systems, University of California, Berkeley; M.S. Structural Engineering, National Taiwan University; B.S. Civil & Environmental Engineering, National Taiwan University
- Ying-Jen Yen, EMBA University of Southern California; MSEE Computer Engineering, Rice University, Houston, Texas; B.S. Engineering, National Central University, Taiwan
- Katie Coughlin, Ph.D. Applied Mathematics, University of Washington, Thesis: *Empirical Mode Decomposition of Atmospheric Variability*; B.S. Physics, California Institute of Technology

Determined that no personnel left the company or project due to a failure to comply with the standards of conduct for their profession.

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

The concerns of the Professional Team noted above during the initial on-site review are no longer pertinent with the reversion to the long term event set.

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

10. G-3.C, page 78 – Describe the process used to validate the ZIP Code data.

Verified: YES

Professional Team Comments:

Reviewed the process for validating the ZIP Code data.

Reviewed the handling of a specific ZIP Code as a check on the process for handling exposure data at this resolution.

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: ~~**NO**~~ **YES**

Professional Team Comments:

Could not be verified since other related Standards were deemed not verified due to theoretical soundness.

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

No bias detected among the meteorological, vulnerability, and actuarial components of the model.

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

For validation of landfall and by-passing storm frequency in the stochastic storm set, the modeler shall use the latest updated Official Hurricane Set or the National Hurricane Center HURDAT as of June 1, 2006 or later. Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

Audit

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

Pre-Visit Letter

11. M-1, Disclosure 2, page 93 – Justify the choice of the shorter historical record comprised of the periods 1926-1970 and 1995-2006 in the light of (1) the exclusion of Hurricane Andrew (1992) from the database; and (2) the use of an earliest year of 1944 by Goldenberg et al. (2001).

12. M-1, Disclosure 2, page 93 – Describe how the years listed in the historical subset were chosen consistent with the methodology of Goldenberg et al. (2001). Provide empirical orthogonal functions and other analyses pertinent to this study.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

According to the Standard, the Base Hurricane Storm Set is for validation of landfall and by-passing storm frequency in the stochastic storm set. Due to the new procedures for landfall frequency determination in the model stochastic set related to the "medium term perspective" implemented this year by the modeler, much information on the frequency calibration process was presented on-site. The procedures discussed are reviewed here. However, since the modeler's approach differed materially from the Standard as written, we were not able to verify this Standard on-site.

Rather than direct application of historical landfall frequencies based on the 107-year historical record, the modeler has implemented an alternative set of landfall frequencies based on interpretation of variability in the historical record. Development of the alternative landfall frequencies arose from the adoption of a medium term perspective for risk assessment. The adjustments to historical frequencies were arrived at through a multi-stage approach involving (1) inspection of the historical record for supporting

data, (2) development of a suite of statistical models with a variety of underlying assumptions; (3) expert elicitation to inform the relative weightings accorded the overall basin and landfall frequencies inferred from the statistical models; (4) expert elicitation to inform the relative partition of storm categories within the basin; (5) modeler determination of the relative distribution of storm types (and resulting storm categories) within the basin, and (6) calculation of the resulting landfall frequencies resulting from this perspective.

In the sense of a year of no landfalls, the 2006 season was included in the modeler's Base Hurricane Storm Set.

The modeler has submitted (and had accepted) an article describing the basic process used for landfall adjustment to Tellus. This article provided limited information on the expert elicitation that directly impacted the hurricane frequencies implemented in RiskLink 6.0a, nor the details of the statistical models presented to the experts. Details of the statistical models presented to the experts involved in the elicitation and the modeler's reasoning in support of selecting this group of models were presented on-site.

The modeler confirmed that the Goldenberg et al. (2001) paper was only used for reference relating to the use of sea surface temperatures (SST) and was not directly implemented in the model. The methodology reported in this paper was not reproduced by the modeler.

Response under Standard M-1, page 93, will be revised to remove the use of "matches" in relation to the National Hurricane Center HURDAT.

Response to M-1.1, page 93, will be revised for clarification on datasets.

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

Verified that the storm set is the Commission's Official Hurricane Storm Set from the 2006 *Report of Activities*.

M-2 Hurricane Characteristics

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

Audit

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

2. Prepare graphical depictions of hurricane characteristics as used in the model. Describe and justify:
   - the data set basis for the fitted distributions,
   - the modeled dependencies among correlated characteristics in the wind field component and how they are represented,
   - the asymmetric nature of hurricanes,
   - the fitting methods used and any smoothing techniques employed.

3. The goodness-of-fit of distributions to historical data will be reviewed.

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

5. The treatment of uncertainties associated with the conversion of gradient winds to surface winds will be compared with currently accepted literature. Variation of the conversion factor with storm intensity will be reviewed.

6. All modeler-specific scientific literature provided in Standard G-1 will be reviewed to determine acceptability.

7. Identify all external data sources that affect model generated wind fields.

Pre-Visit Letter

13. M-2, page 94 – Describe how distributions of hurricane characteristics (e.g., RMAX) were modified in the light of the reduced "historical" hurricane set.

14. M-2, Disclosure 1, page 95 – How were discrepancies between the radii given in the Extended Best Track (EBT) and H*Wind for the 2000 storms resolved? Why was the change made from EBT to H*Wind?

15. M-2, Disclosure 10, page 100 – Provide the parameters used for these three storms.

Verified: YES

Professional Team Comments:

Response to M-2.1 will be revised to expand on the description of historical data sets used for each of the storm characteristics.

Reviewed how distributions of hurricane characteristics changed in light of the reduced historical hurricane set.

Reviewed cumulative distribution functions of storm characteristics resulting from the medium term perspective (see Standard S-1).

Reviewed comparisons of Rmax distribution by central pressure band between version 5.1a and version 6.0a.

Reviewed the central pressure, translational velocity, and Rmax parameters used for Hurricanes Charley, Katrina, and Wilma.

Reviewed some discrepancies in Rmax between the Extended Best Track and H*Wind datasets for the 2004 hurricanes and the process used for selecting the Rmax input into the model. Discussed how no other data sources were employed to resolve these discrepancies.

Reviewed the methodology for developing the windfield shape parameter in the model wind field.

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

Response to M-2.1 has been revised to correct time period used for development of minimum central pressure and forward speed.

M-3 Landfall Intensity

Models shall use maximum one-minute sustained 10-meter wind speed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm Set used to develop landfall strike probabilities as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter wind speed shall be within the range of wind speeds (in statute miles per hour) categorized by the Saffir-Simpson scale.

Saffir-Simpson Hurricane Scale:

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

Audit

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

Pre-Visit Letter

16. M-3, Disclosure 1, page 101 – Explain the qualifier "(per disclosure M-1.2)".

Verified: YES

Professional Team Comments:

Response to M-3.1, page 101, will be revised to remove the qualifier "(per disclosure M-1.2)."

Verified landfall intensity is measured by the maximum 1-minute sustained wind speed.

M-4 Hurricane Probabilities

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

B. Modeled hurricane probabilities shall reflect the Base Hurricane Storm Set used for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).

Audit

1. Modeled probabilities are compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical hurricane frequencies for the four regions of Florida and overall as provided in Form M-1 will be reviewed.

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

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

4. Describe and support the method of selecting storm track strike intervals. If strike locations are on a discrete set, show the landfall points for major metropolitan areas in Florida.

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

6. Describe any short term and long term variations in annual storm frequencies incorporated in the model.

Pre-Visit Letter

17. M-4, Disclosure 2, page 103 – Describe whether the "perspective of risk over the next five years, effective 2007-2011" should be expected to change within that time window. If so, describe what might cause it to change.

18. M-4, Disclosure 2, pages 103-104 – Describe the statistical analyses and statistical models used to determine the new perspective of risk. Provide detailed calculations for these.

19. M-4, Disclosure 2, page 104 – Referring to paragraph, "A suite of statistical models…," describe the cited "mixed baseline methodology."

20. M-4, Disclosure 2, page 104 – What environmental parameters, other than sea surface temperature were considered in the climatological analyses referenced here?

21. M-4, Disclosure 2, page 104 – Referring to paragraph, "Results from those models…," provide names and credentials for the hurricane experts involved in the 2006 panel. Describe how the panel was conducted and the process by which a resolution was achieved. Provide information on whether any of the panelists has subsequently publicly changed his or her position.

22. M-4, Disclosure 2, page 104 – Referring to paragraph, "Further statistical analyses…," describe the storm parameters examined. As a result of this analysis, describe any revisions made to the track model or intensity model.

23. [This question is under Standard M-5]

24. Form M-1, page 111 – Demonstrate how the adjustments to the historical frequencies for the regions were determined.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Related to the model probability distribution developed from medium term expert elicitation process. See Professional Team comments for Standard G-2.

Revised Form M-1, pages 111-112, will be provided to correct historical counts for Cat 5 storms in Southeast Florida and the Note provided under Table 9. Confirmed Form M-1 was completed using the 57-year historical record for comparison.

Reviewed the methodology underlying the new hurricane event rates in the Atlantic basin using a medium-term perspective. Discussed chi-square statistical tests on the changes in Florida activity rates across the periods of 1926-1969, 1970-1994, and 1995-2006 identified by Goldenberg et al. (2001).

Reviewed the medium-term perspective methodology including:

- Development of a suite of statistical models to estimate expected activity in the Atlantic and for U.S. landfalls
- Elicitation of expert opinions on what best represents future levels of activity
- Study of regionalization using RMS definition of storm types, including the change in distribution of storms by type and intensity and among storms of a same type (storm types are modeler classification)
- Implementation of results by storm types and intensity.

Reviewed the RMS five different types of storms (by genesis) and examples of historical storms by type.

Reviewed the elicitation process for the expert opinions obtained. Reviewed the selection process for the experts and the experts involved. Reviewed list of peer-reviewed published papers over the last 10 years by experts on the relevant topic.

Reviewed documentation provided to the experts prior to the elicitation and a portion of the material presented at the elicitation workshop. Reviewed the questions asked and the weighted results from the experts.

Reviewed the twenty statistical models by classes of prediction for US landfalling hurricane numbers that were developed and presented to the experts at the elicitation.

Reviewed the use of historical data in the medium-term methodology:

- Relies on all data across the 1900 to 2006 period for assessing U.S. landfalls
- Statistical models presented at the elicitation relied on data up to 2005
- Statistical models used to estimate the basin activity include only data after 1950 which was deemed reasonable by the expert panel
- No adjustments were made to HURDAT records.

Reviewed the regionalization approach implemented including:

- Study of the distribution of storms by type in periods of heightened activity
- Study of hurricane activity of storms approaching the U.S. coastline, as a function of storm intensity to determine whether all storms of one type are affected the same way
- Findings from the studies combined to generate a distribution across storm types and intensity
- Implementation conducted on the increment in hurricane frequencies.

Reviewed distribution of U.S. landfalling Category 1-5 storms by type for the long term historical record (1900-2005) and for periods of heightened activity of 1995-2005 historical data and subset of 1900-2005 historical data adding one standard deviation.

Reviewed comparison of medium term and historical distribution of storms by type in Florida of RiskLink version 5.1a and RiskLink version 6.0a.

Reviewed main development region (MDR) sea surface temperature (SST) time series with predictions based on an 8-year moving average and a 22-year trend analysis. Reviewed comparison between RMS SST trends and other sources of trend information.

Clarified under Standard M-4 the basis for developing probability distributions for each of storm parameters was the 1900-2006 HURDAT dataset.

Discussed the environmental parameters ENSO and QBO that were considered in the climatological analyses and confirmed that sea surface temperature was the only major consideration.

Reviewed in the computer code the adjustment to landfall frequencies to incorporate the modifications to annual storm frequencies.

Reviewed Rmax range with reference to small storms such as Charley (2004).

Discussed how the elicitation process is planned to be conducted annually to update medium term perspective.

Discussed how "mixed baseline methodology" was intended to derive maximum predictive information from the historical record.

Documentation reviewed:

- Changes in the Rates of North Atlantic Major Hurricane Activity During the 20th Century, James B. Elsner, Thomas Jagger, and Xu-Feng Niu, Geophysical Research Letters, Vol. 27, No. 12, Pages 1743-1746, June 15, 2000.
- Tropical Cyclone Reconstructions from Documentary Records: Examples for South Carolina, United States, Cary J. Mock, Hurricanes and Typhoons Past, Present, and Future, Richard J. Murnane and Kam-Biu Liu, Editors, Columbia University Press, Pages 121 – 148, 2004.
- Predicting Hurricane Numbers from Sea Surface Temperature: Closed Form Expressions for the Mean, Variance and Standard Error of the Number of Hurricanes, Stephen Jewson, January 15, 2007, http:www.stephenjewson.com, arXiv:physics/0701167v1
- Year-ahead Prediction of Hurricane Season Sea Surface Temperature in the Tropical Atlantic, Jonathan Meagher, Stephen Jewson, June 21, 2006, http:www.stephenjewson.com, arXiv:physics/0606185v1
- Five Year Prediction of Sea Surface Temperature in the Tropical Atlantic: A Comparison of Simple Statistical Methods, Thomas Laepple, Stephen Jewson, Jonathan Meagher, Adam O'Shay, Jeremy Penzer, January 16, 2007, http:www:stephenjewson.com, arXiv:physics/0701162v1
- Predicting Landfalling Hurricane Numbers from Sea Surface Temperature: Theoretical Comparisons of Direct and Indirect Approaches, Stephen Jewson, Thomas Laepple, Kechi Nzerem, Jeremy Penzer, January 29, 2007, http:www.stephenjewson.com, arXiv:physics/0701176v2
- Predicting Basin and Landfalling Hurricane Numbers from Sea Surface Temperature, Stephen Jewson, Roman Binter, Shree Khare, Kechi Nzerem, Adam O'Shay, January 29, 2007, arXiv:physics/0701170v2

Additional Verification Review Comments

The concerns of the Professional Team noted above during the initial on-site review are no longer pertinent with the reversion to the long term event set.

M-5 Land Friction and Weakening

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

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

Audit

1. Identify other variables in the model that affect over land wind speed estimation.

2. Maps depicting land friction effects are required. Describe the representation of land friction effects in the model. Describe the variation in decay rate over land used in the model.

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

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

5. Form M-2 will be reviewed.

Pre-Visit Letter

23. M-5, Disclosure 5, page 109 – Discuss the filling rates possible in the stochastic storm set compared to the observed range of filling rates.

24. [This question is under Standard M-4]

25. Form M-2, page 113 – Although the caption for Figure 11 refers to the 57-year database, the maximum plotted wind speed and the details of the plot appear to be identical to last year.

Verified: YES

Professional Team Comments:

Reviewed plot of filling rates for Hurricanes Charley, Frances, Ivan, and Jeanne in 2004 and Hurricanes Dennis, Katrina, and Wilma in 2005 compared to the Kaplan-DeMaria filling rate.

Reviewed the modeled slow and fast filling rates compared to observed wind speeds at several observation stations for Hurricane Charley.

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

Verified that the actual roughness database used for clients is used in preparing Form M-2.

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed Form M-3 and comparisons of Rmax distribution by central pressure band between version 5.1a and version 6.0a.

Determined that Rmax bounds in Form M-3 are evaluated from the stochastic storm set relevant to Florida used in the model.

VULNERABILITY STANDARDS – Fred Stolaski, Leader

V-1 Derivation of Vulnerability Functions

A. Development of the vulnerability functions is to be based on a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. Any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, or historical data.

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

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

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

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

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

G. The minimum wind speed that generates damage shall be reasonable.

Audit

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

2. Copies of any papers, reports, and studies used in the development of the vulnerability functions should be available for review. Copies of all public record documents used may be requested for review.

3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense should be available. The magnitude of logical changes among these items for a given wind speed shall be explained and validation materials should be available.

4. Justify the construction types and characteristics used, and provide validation of the range and direction of the variations in damage.

5. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement.

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

7. Form V-1 will be reviewed.

Pre-Visit Letter

26. V-1, Disclosure 2, page 121 – Provide material cited as available for review by the Professional Team.

27. V-1, Disclosure 2, page 121 – Provide insurance claims data for storms from 2004 and 2005 and describe any modifications made to the vulnerability functions due to these claims.

28. V-1, Disclosure 3, page 123 – Discuss any modifications to the vulnerability functions due to the results of recent site inspections.

Verified: YES

Professional Team Comments:

Response to V-1.5, page 126, Table 12 will be revised to round the values given for the square footage bands.

Reviewed the underlying methodology for the development of new vulnerability functions for single-family residential properties that vary with square footage. The four new square-footage bands implemented are:

- Less than 1,500 sq.ft.
- 1,500 – 2,000 sq.ft.
- 2,000 – 4,500 sq.ft.
- Greater than 4,500 sq.ft.

Reviewed the impact of square footage on the mean damage ratio for frame and masonry structures.

Reviewed claims data containing square footage information and the process for estimating square footage information if missing in the claims data.

Reviewed how square footage is calculated and input into the model.

Reviewed validation of square footage estimating technique against observed data using a corrected scatterplot.

Reviewed process for determining the various vulnerability curves applied in the model. Reviewed process for validating and checking for consistency among vulnerability curves.

Reviewed distribution of high value homes comparing a typical residential portfolio to a portfolio that focuses on high value homes.

Reviewed summary of claims data including high value homes.

Reviewed square footage curve for one-story wood frame ground-up mean damage ratio by wind speed.

Reviewed the impact on average annual loss of implementing the square footage bands.

Reviewed insurance claims data for storms from 2004 broken down by insurance company and storm.

Reviewed multiple examples of carport and screen enclosure damage from four recent storms and discussed type and magnitude of damage.

Confirmed that no new engineering data has been received or field surveys conducted since the previous review.

Reviewed the approach used to create Figure 15 and discussed magnitude of “peak gust” wind values used in graph.

Documentation reviewed:

- Client Claims/Exposure Data Summary Document

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

Verified that there were no changes to the vulnerability functions from the February submission.

Verified that no changes were required to the previously submitted Form V-1.

V-2 Mitigation Measures*

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

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 wind speeds 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

29. V-2, Disclosure 2, page 129 – Describe briefly the "IBHS Fortified Program".

30. Form V-2, page 135 – Provide calculations resulting in many 0.0% values for the ranges at 85 mph for Frame Structures.

31. Form V-3, page 136 – Please complete the REFERENCE STRUCTURE row in Form V-3. Provide a copy of Form V-3 when the Professional Team arrives, and 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.)

Verified: YES

Professional Team Comments:

Reviewed the rationale for disabling the use of secondary modifiers when any of the primary variables such as construction, occupancy, number of stories, and year built are unknown.

Reviewed new secondary modifier for the Fortified…for Safer Living™ program for new wood and masonry residential single-family buildings administered by the Institute for Business and Home Safety. Verified that this modifier not used at the same time as individual mitigation measures.

Reviewed change to the foundation modifier for wood frame buildings to bring consistency to the model for engineered and non-engineered foundations.

Reviewed the development of the new carport/screen enclosure modifier for manufactured homes based on site inspections and engineering judgment.

Reviewed spread sheets from which Forms V-2 and V-3 were constructed and reviewed process for translating into computer code. Reviewed zero values in Form V-2 for Frame Structure at 85 mph and determined it was due to a cap on damage rates for individual mitigation measures at a specific wind speed. Reviewed process by which development of spread sheet with macros was checked and tested.

Verified that the software for secondary modifiers has been set to inactive for exposures lacking information on primary modifiers.

Documentation reviewed:

- Fortified…for safer living…Builder's Guide, January 2005.

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

Verified that no changes were required for the previously submitted Form V-2 and that Form V-3 that was reviewed on-site.

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 wind speeds or greater on land in Florida.

Audit

1. The model will be reviewed to determine that the definition of an event in the model is consistent with Standard A-1.

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

Verified: YES

Professional Team Comments:

Discussed with Kay Cleary her review and confirmation that there were no changes in the model relative to the definition of an event and the handling of 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:

Discussed with Kay Cleary her review of the methods of handling claims data and verified no changes were made from the previous year.

Confirmed no new claims data has been analyzed since our previous review.

A-3 Loss Cost Projections*

*(*Significant Revision)*

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:

Discussed with Kay Cleary her review and confirmation that the method for producing loss costs has not changed from the previous submission.

A-4 Demand Surge*

*(*New Standard)*

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

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.

Pre-Visit Letter

32. A-4, pages 141-142 – Provide a detailed description of the process used in the model to account for demand surge, including any analyses performed to determine that the resulting demand surge adjustments are actuarially reasonable. Have available any data, reports, expert opinions, etc. used in developing this process.

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.

- Economic Demand Surge Model – based on understanding of economic drivers of increases in labor costs and building materials as demand exceeds supply.
- Claims Inflation – based on difficulties in fully adjusting claims following a catastrophic event.
- 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 functions.

Reviewed fit of 2004 claims data used to develop the relationship between portfolio mean damage ratio and claims ratio.

Reviewed the contributions of the "Loss Amplification" models (economic demand surge, claims inflation, and super CAT loss amplification) to the average annual loss by county.

Discussed with Kay Cleary her review of the development and implementation of the new demand surge model.

Reviewed the computer code for the “Loss Amplification” model.

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

Reviewed the Loss Amplification factors for the long term event set. Reviewed validation plot for building, contents, and ALE losses comparing the Loss Amplification factors for the medium term event set with the long term event set.

Verified the Loss Amplification factors were not affected by the reversion to the long term event set.

Compared effect of Loss Amplification factors on loss costs for both storm sets. Verified that percentage changes were consistent.

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 should include methods to assure accuracy of insurance data. Compliance with this Standard will be readily demonstrated through documented rules and procedures.

2. All insurer inputs and assumptions will be reviewed.

Pre-Visit Letter

33. A-5, Disclosure 4, page 145 – Show computer screens and computer code processes used in the following validation procedures:
    Geocoding – street, ZIP Code, etc. (first bullet)
    Construction/occupancy defaults (third bullet)
    Content grade (eight bullet)
    Square footage default (last bullet)

Verified: **YES**

Professional Team Comments:

Discussed with Kay Cleary her review and confirmation that no changes were made in the methodology regarding user inputs in the model from the previous submission.

Reviewed computer code used in the validation procedures for geocoding, construction and occupancy defaults, contents coverage, and the square footage default.

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

39. Form A-3, pages 168-169 – Explain the contribution values provided in Table 17 as it relates to Form S-4.

40. Form A-5, page 179 – Describe the process used to produce figure 24, including computer code or other means used to generate figure 24.

Verified: YES

Professional Team Comments:

Discussed with Kay Cleary her review of the various forms.

Reviewed the historical storm set used to complete Forms A-3 and S-4. Form A-3 uses the complete historical storm set, 107 years, and Form S-4 uses the modified base storm set, 57 years.

Reviewed methods and procedures used to generate Figure 24 in Form A-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.

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed with Kay Cleary her review and confirmation that no changes were made in the model relative to applying deductibles and policy limits from the previous submission.

Reviewed the application of policy limits for structural loss and the application of aggregate deductibles in the computer code.

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. To the extent that historical data are used to develop mathematical depictions of contents functions, demonstrate the goodness-of-fit of the data to fitted models. Justify changes from the prior submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Professional Team unable to verify Standard A-8 due to concerns expressed under Standard G-2 relative to techniques used in development of the "medium term" perspective.

Discussed with Kay Cleary her review and confirmation that no changes were made in the model relative to contents losses from the previous submission.

Reviewed in the computer code the application of contents losses.

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

Reviewed revised contents loss costs for the long term event set.

A-9 Additional Living Expense (ALE)

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

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

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

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.

Pre-Visit Letter

34. A-9, Disclosure 1, page 157 – Provide a description of the differences in the time element vulnerability functions among frame owners, frame contents, masonry owners, and masonry contents.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Professional Team unable to verify Standard A-9 due to concerns expressed under Standard G-2 relative to techniques used in development of the "medium term" perspective.

Discussed with Kay Cleary her review and confirmation that no changes were made in the model relative to ALE losses from the previous submission.

Reviewed the methodology for developing and implementing ALE losses in the model. ALE losses are only considered in the model if there has been damage to the structure.

Reviewed in the computer code the application of ALE losses.

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

Reviewed revised ALE loss costs for the long term event set.

A-10 Output Ranges

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

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

1. masonry construction versus frame construction,

2. residential risk exposure versus mobile home risk exposure,

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

4. in general, northern counties versus southern counties.

Audit

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

2. The modeler will be required to justify the following:
   a. Changes from the prior submission of greater than five percent in weighted average loss costs for any county.
   b. Changes from the prior submission of five percent or less in weighted average loss costs for any county.

3. Output ranges will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.

4. Anomalies in the output range data will be reviewed and shall be justified.

Pre-Visit Letter

35. A-10, Disclosure 2, page 159 – Provide a detailed description of the "new view of hurricane frequency in the Atlantic". Provide data, calculations, methods, and procedures used in the development of the *new view*. Provide the following information relative to the *new view* and its effect on loss costs relative to the long term frequency calculations.

    1) Describe analyses performed to determine whether the effects upon loss costs produced using the *new view* methodology relative to those produced using a long term frequency methodology vary with location. Provide the following information:

       a. How do the effects on loss costs vary relative to the hurricane's origination point? Provide analyses to support the response and to support the relative model methodologies.

b. How do the effects on loss costs vary relative to landfall location (i.e. Gulf Coast vs. Atlantic)? Provide analyses to support the response and to support the relative model methodologies.

i. If the *new view* methodologies were employed separately, for Gulf Coast landfalling hurricanes based on Gulf Coast historical landfall data, and for Atlantic Coast landfalling hurricanes based on Atlantic Coast historical landfall data, how would the resulting output ranges compare with the *new view* loss costs in these output ranges?

ii. Provide any analyses performed to determine how loss cost differences between the *new view* and a long term frequency view compare along the entire hurricane exposed Atlantic Coast. Provide analyses to support the response and to support the relative model methodologies.

c. How do the effects on loss costs vary relative to landfall angle? Provide statistical analyses to support the response and to support the relative model methodologies.

d. Describe studies and analyses performed to determine in what manner the latitudinal effects of extra-tropical transition are altered temporally within the five year time period or in the determination of the five year time period and how those differences were considered in the *new view* model.

e. Provide any analyses performed relative to differences in the loss costs produced by the *new view* model relative to those produced by the previously accepted long term frequency model for inland and coastal properties separately. Provide analyses to support the response and to support the relative model methodologies.

2) Describe any differences in the data collection techniques used throughout the historical period used as the basis for the *new view* calculations, including:

a. Differences in data quality due do changes in the scientific methods (i.e. satellite imagery, improved meteorological science, etc.) available throughout the historical period, and how those differences are accounted for in developing the *new view* loss costs. Provide scientific and statistical support for this process.

b. Differences in data quality due to changes in the scientific tools (i.e. dropsondes, more effective measurement equipment and stations, etc.) available throughout the historical period, and how those differences are accounted for in developing the *new view* loss costs. Provide scientific and statistical support for this process.

36. A-10, Disclosure 2, page 160 – Referring to bullet, "Introduction of vulnerability functions…," describe in detail the studies, data, calculations and resulting loss costs (including computer code) of the square footage adjustments available in the model.

37. A-10, Disclosure 2, page 160 – Referring to bullet, "Changes to some secondary…," provide a similar description to that requested in the item above for each bullet item listed under secondary modifiers.

38. A-10, Disclosure 2, pages 160-162 – Discuss value of percentage change in Monroe County relative to the adjacent counties in Table 16.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Professional Team unable to verify Standard A-10 due to concerns expressed under Standard G-2 relative to techniques used in development of the "medium term" perspective.

Discussed with Kay Cleary her review of the differences in the output ranges from the previous submission.

Reviewed the percent differences in the average annual loss by county for each individual modification made to the model from version 5.1a to version 6.0a.

Reviewed the impact on loss costs by hurricane type (based on storm genesis) and the effect on category 4 and 5 storms by changing the frequency of storm types.

Reviewed the changes in loss costs by storm landfall angle and a plot showing the changes are minimal to the overall Florida loss costs.

Reviewed the changes in loss costs by degree of transition and a plot showing the changes are minimal to the overall Florida loss costs.

Reviewed the use of the HURDAT database and that no adjustments were made to the parameters given in HURDAT due to data quality issues.

Reviewed in Form A-7 the small percentage differences for Masonry Renters, Frame Condos, and Masonry Condos in the North and the large percentage differences for Masonry Owners in Coastal counties.

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

The concerns of the Professional Team noted above during the initial on-site review are no longer pertinent with the reversion to the long term event set.

Reviewed revised Forms A-6, A-7, and A-8 comparing results from medium term rates to long term rates.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

A. The use of historical data in developing the model shall be supported by rigorous methods published in currently accepted scientific literature.

B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods.

Audit

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

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

Pre-Visit Letter

41. S-1.B, page 243 – Describe in detail the adjustments using 57 years of data. How do all of the comparisons between historical and modeled variables hold up under this circumstance?

42. S-1, Disclosure 1, page 244 – Provide a discussion of p-values for the 57 years of data in contrast to the Base Hurricane Storm Set.

43. S-1, Disclosure 6, pages 251-252 – Relative to Figures 36 and 37, the empirical distribution function appears to have changed, but the p-values have not.

49. Form S-1, page 268 – Provide a detailed description of the historical and modeled probabilities and include a description of the historical time period used for each column.

Verified: ~~**NO**~~ **YES**

Professional Team Comments:

Related to Standards M-1 and M-4 for the frequency distribution of hurricanes.

Response to S-1.1, page 244, will be revised to correct the p-values given for the statistical tests under landfall frequency.

Response to S-1.2, page 245, will be revised to clarify that the landfall rates were developed using HURDAT 1900-2006.

Response to S-1.5, pages 247-249, Figures 32, 33, & 34, will be updated. Figures provided in the original submission were from the previous year's submission.

Response to S-1.6, page 252, Figure 37, x-axis label to be revised for clarity.

Revised Form S-2, page 269, will be provided to correct the probability of exceedance provided for the top event.

Reviewed the use of the 57 years of warm period data in comparing with storm characteristics in the stochastic set applicable to Florida. Reviewed the use of various subsets of the historical record for estimating different hurricane characteristics. Reviewed corrections to the original submission.

Reviewed the historical and modeled probabilities provided in Form S-1.

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

The concerns of the Professional Team noted above during the initial on-site review are no longer pertinent with the reversion to the long term event set.

S-2 Sensitivity Analysis for Model Output

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

Audit

1. The modeler's sensitivity analysis will be reviewed in detail. Statistical techniques used to perform sensitivity analysis shall be explicitly stated. The results of the sensitivity analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

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

Pre-Visit Letter

44. S-2, Disclosure 2, page 256 – Justify the final sentence provided in the response.

45. S-2, Disclosure 3, page 257 – Provide the plots associated with the sensitivity tests.

46. S-2, Disclosure 4, page 257 – Expand on the response provided and comment on the sensitivity in light of your response to Disclosure 3.

Verified: YES

Professional Team Comments:

Response to S-2.1, pages 254-256, Figures 38, 39, & 40, will be updated. Figures provided in the original submission were from the previous year's submission.

Reviewed various sensitivity tests in the context of Meteorological Standards. Reviewed historical work on sensitivity tests. Determined that additional work as in Form S-5 was not required.

S-3 Uncertainty Analysis for Model Output

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

Audit

1. The modeler's uncertainty analysis will be reviewed in detail. Statistical techniques used to perform uncertainty analysis shall be explicitly stated. The results of the uncertainty analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

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

Pre-Visit Letter

47. S-3, Disclosure 3, page 259 – Provide the plots associated with the uncertainty tests.

48. S-3, Disclosure 4, page 259 – Expand on the response provided and comment on the uncertainty in light of your response to Disclosure 3.

Verified: YES

Professional Team Comments:

Reviewed various uncertainty analyses in the context of Meteorological Standards and the elicitation process. Reviewed historical work on uncertainty tests. Determined that additional work as in Form S-5 was not required.

S-4 County Level Aggregation

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the importance sampling process for adjusting the landfall frequency rates by type (storm genesis), category (Saffir-Simpson), and gate (landfall location) to achieve convergence on the average annual loss by county with less than 1% deviation from results for the entire stochastic storm set.

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 wind field applied to a particular hurricane for the purpose of validation and the wind field used in the model under consideration,
   h. The type of property used in each hurricane to address:
      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.

Verified: YES

Professional Team Comments:

Form S-3 (Figures 43-47) as originally submitted did not include demand surge as part of the modeled results. Reviewed a corrected Form S-3 with demand surge included. A corrected Form S-3 will be provided in the revised 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-4 will be reviewed.

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

Pre-Visit Letter

50. Form S-4, page 275 – Provide a discussion of the use of the 57 years of data relative to this Form.

Verified: YES

Professional Team Comments:

Clarified the use of the storms involved in completing Form S-4.

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

Reviewed the further revised Form S-4 in conjunction with Form A-3.

Reviewed validation comparisons of average annual loss results on a county basis after reverting to the long term event set.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

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

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

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

Audit

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

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

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

4. Modeler personnel, or their designated proxies, responsible for each aspect of the software (i.e. user interface, quality assurance, engineering, actuarial) shall be present when the Computer Standards are being audited. Internal users of the software will be interviewed.

5. Provide verification that documentation is created separately from the source code.

Pre-Visit Letter

51. Provide material cited as available for review by the Professional Team under C-1 (page 277), C-2 (page 278), C-3 (page 280), C-4 (page 282), and C-6 (page 291).

52. C-1, page 277 – Provide documentation on all code and data relating to G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed the documented training program designed to strengthen the application of the Computer Standards throughout the organization, and for new personnel.

Reviewed the primary document binder maintained in electronic format with folder hierarchy indexes for material organized by Standard.

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.

Pre-Visit Letter

51. Provide material cited as available for review by the Professional Team under C-2 (page 278)

52. [This question is under Standard C-1]

53. C-2, page 278 – Provide documentation on the new requirements indicated by G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed requirement documents associated with software and data management changes as a result of items delineated in the modeler's response to G-1, Disclosure 5:

- A 2004 memorandum concerning different modeling approaches for estimating hurricane frequencies
- The method of modeling loss amplification
- The use of square footage for modification of base vulnerability functions.

C-3 Model Architecture and Component Design

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

Audit

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

2. A model component custodian, or designated proxy, should be available for the review of each component.

Pre-Visit Letter

51. Provide material cited as available for review by the Professional Team under C-3 (page 280)

54. C-3, pages 280-281 – Describe how the items in G-1, Disclosure 5 are reflected in changes to the model architecture and component design.

Verified: YES

Professional Team Comments:

Reviewed the RiskLink 6.0a flowchart illustrating model control flow.

Reviewed the vulnerability database flowchart specifying the procedure for managing the damage curves.

Reviewed the flowchart for computing loss amplification.

C-4 Implementation

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

B. The modeler shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.

C. All components shall be traceable, through explicit component identification in the flow diagrams, down to the code level.

D. The modeler shall maintain a table of all software components affecting loss costs, with the following table columns: (1) Component name, (2) Number of lines of code, minus blank and comment lines; and (3) Number of explanatory comment lines.

E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

Audit

1. The interfaces and the coupling assumptions will be reviewed.

2. Provide the documented coding guidelines and confirm that these guidelines are uniformly implemented.

3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.

4. The traceability among components at all levels of representation will be reviewed.

5. The following information shall be available and will be reviewed for each component, either in a header comment block, source control database, or the documentation: component name, date created, dates modified and by whom, purpose or function of the component, and input and output parameter definitions.

6. The table of all software components as specified in C-4.D will be reviewed.

7. Model components and the method of mapping to elements in the computer program will be reviewed.

8. Comments within components will be examined for sufficiency, consistency, and explanatory quality.

Pre-Visit Letter

51. Provide material cited as available for review by the Professional Team under C-4 (page 282)

55. C-4, pages 282-283 – Show the modified code implementation resulting from the changes in G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed the implementation of limits to the total modification factor for the mean damage ratio used in the model.

Reviewed the method by which the vulnerability code is translated in RiskLink 6.0a as an approach to model implementation and verification.

Reviewed the landfall rate adjustment in the meteorology code.

Reviewed the method for implementing the square footage default.

Reviewed the approach used to specify and validate inputs for content coverage.

Reviewed geocoding strategies for specifying a hierarchically organized set of functions to aid in validation.

Verified that the secondary modifiers are not considered when the primary variables are not specified.

Reviewed the code for calculating the impact of modifiers on the base vulnerability function.

Verified the implementation of the vulnerability bands for square footage.

Reviewed the method for computing loss amplification.

Reviewed approach used to code coverage input limits.

Reviewed that there was no change to the code for computing the annual deductible from the prior year's submission.

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

Reviewed C++ implementation and form-based graphical user interface to ensure that the long term event set is being accessed by the model.

C-5 Verification

A. General

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

B. Component Testing

1. The modeler shall use testing software to assist in documenting and analyzing all components.

2. Unit tests shall be performed and documented for each component.

3. Regression tests shall be performed and documented on incremental builds.

4. Aggregation tests shall be performed and documented to ensure the correctness of all model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

C. Data Testing

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

2. The modeler shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.

Audit

1. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.

2. The testing software used by the modeler will be reviewed.

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed.

Pre-Visit Letter

56. C-5, pages 284-287 – Describe the code and data testing and verification procedures resulting from the changes in G-1, Disclosure 5.

57. C-5, pages 284-287 – Provide details of the procedures and training courses proposed by RMS during the prior on-site review (as a result of errors discovered during that review) relative to improvements in the verification procedures.

Verified: YES

Professional Team Comments:

Reviewed the cross-check verification procedure used for validating the method of filling out Form V-3.

Reviewed the Quality Assurance test plans for components of RiskLink 6.0a.

Reviewed the test plan associated with loss amplification factors.

Reviewed the use of logical assertions used in the code containing damage function modifiers.

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

Verified the implementation of the Test Plan for the Geocoding/Hazard implementation, designated to ensure the accuracy of RiskLink 6.0a model results.

C-6 Model Maintenance and Revision

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

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

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

Audit

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

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

Pre-Visit Letter

51. Provide material cited as available for review by the Professional Team under C-6 (page 291)

58. C-6, pages 288-291 – Describe how the changes in G-1, Disclosure 5 are reflected by the requirements for this Standard.

Verified: YES

Professional Team Comments:

Reviewed the policy for model revision, including a detailed control flow chart of the process of model maintenance and revision.

Reviewed the use of SourceSafe to track all aspects of the model, including data, code, and documentation.

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

Verified that RMS does not release the model for use by clients until the model version has been found acceptable by the Commission.

Verified that the RiskLink version 6.0a software implementation has not been used outside of the modeler's organization.

C-7 Security

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

Audit

1. The written policy for all procedures and methods used to ensure the security of code, data, and documentation will be reviewed. Specify all security procedures.

2. Documented security procedures for access, client model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

Verified: YES

Professional Team Comments:

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

Reviewed the new RMS security awareness program, which is part of the revised training process.

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

Reviewed secure access to code, data, and documentation on the modeler revisit on June 20, 2007.