Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2007 Standards

Florida Public Hurricane Loss Model

On-Site Review
April 8-10, 2008

Additional Verification On-Site Review
June 3-4, 2008

On April 8-10, 2008, the Professional Team visited on-site at Florida International University in Miami, Florida. The following individuals participated in the review.

FIU

Bachir Annane, Senior Research Associate III, CIMAS/HRD
Min Chen, Consultant, Assistant Professor of Computer Science, University of Montana
Shu-Ching Chen, Ph.D., Associate Professor, School of Computing and Information Science, Florida International University
Steve Cocke, Ph.D., Associate Scholar/Scientist, Department of Meteorology and COAPS, Florida State University
Gail Flannery, FCAS, MAAA, Consulting Actuary, AMI Risk Consultants, Inc.
Fausto Fleites, Student Programmer and B.S. Candidate, Florida International University
Kurt Gurley, Ph.D., Associate Professor, Department of Civil and Coastal Engineering, College of Engineering, University of Florida
Shahid Hamid, Ph.D., CFA, Professor, Director of MSF Program, Florida International University, Director Lab for Insurance, Financial Economic Research, International Hurricane Research Center
Golam Kibria, Ph.D., Associate Professor, Department of Statistics, Florida International University
Jean Paul Pinelli, Ph.D., Professor, Civil Engineering Department, Florida Institute of Technology
Mark Powell, Ph.D., Senior Atmospheric Scientist, NOAA Hurricane Research Division, AOML

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. The Professional Team reviewed FIU's responses to the deficiencies noted at the March 12, 2008 Commission meeting during the course of the review.

Late on day two of the audit, an error was discovered that necessitated a re-generation of the output ranges in Forms A-6A and A-6B and all other Forms involving year of construction. Owing to the many substantial issues raised before and during the audit, numerous other Standards could not be verified during the audit.

The Professional Team reviewed the following corrections to be included in the revised submission.

1. Page 21, G-1.2 – modified wording for the last sentence relative to "statistically significant."
2. Page 27, G-1.2 – removal of sentence in second paragraph under "Appurtenant Structures" relative to "B parameter."

3. Pages 36-51, G-1.4 – references corrected for inconsistencies and missing information, reference added for website link for NOAA's Coastal Services Center.
4. Page 86, M-4.1 – Figure 9 corrected.
5. Page 93, M-5.2 – Hurricane Frances in Figure 13 corrected.
6. Page 98, Form M-1 – revised for correct historical values.
7. Page 100, Table 6 – revised for correct values in the expected and observed where they had been reversed and bins with <5 counts but >10% of the total count combined.
8. Pages 133-136 – revised Forms V-2 and V-3 and Figures 33 and 34.
9. Page 206, S-1.1 – removal of "new" in first sentence relative to Rmax model.
10. Page 215, S-1.5 – clarification on the 95% confidence interval.
11. Page 225, S-4.1 – corrected wording in last sentence relative to "optimal number of simulations" and corrected value given in formula for X_y.
12. Page 227, S-5.1 – revised Table 19 to correct values given for Hurricane Charley, Company D.

Additional Verification Review – June 3 & 4, 2008

Florida International University submitted revisions to the original February 28, 2008 model submission under the 2007 Standards on May 15, 2008, and submitted additional revisions with the deficiency responses to the revised submission provided on May 29, 2008. The Professional Team completed the additional verification review on June 3 & 4, 2008 in Miami. **All Standards are now verified**.

The following individuals participated in the additional verification review:

FIU

Bachir Annane, Senior Research Associate III, CIMAS/HRD
Shu-Ching Chen, Ph.D., Associate Professor, School of Computing and Information Science, Florida International University
Steve Cocke, Ph.D., Associate Scholar/Scientist, Department of Meteorology and COAPS, Florida State University
Gail Flannery, FCAS, MAAA, Consulting Actuary, AMI Risk Consultants, Inc.
Fausto Fleites, Student Programmer and B.S. Candidate, Florida International University
Kurt Gurley, Ph.D., Associate Professor, Department of Civil and Coastal Engineering, College of Engineering, University of Florida
Shahid Hamid, Ph.D., CFA, Professor, Director of MSF Program, Florida International University, Director Lab for Insurance, Financial Economic Research, International Hurricane Research Center
Golam Kibria, Ph.D., Associate Professor, Department of Statistics, Florida International University
Jean Paul Pinelli, Ph.D., Professor, Civil Engineering Department, Florida Institute of Technology
Mark Powell, Ph.D., Senior Atmospheric Scientist, NOAA Hurricane Research Division, AOML

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

The review began with an overview of the additional verification review process and a recap of the previous findings from the initial on-site review on April 8-10, 2008. The Professional Team indicated it would be focusing on the changes to the model indicated in the revisions submitted on May 15, 2008 and in the responses to the deficiencies submitted on May 29, 2008.

FIU indicated the changes in the model since the initial submission were only in the meteorological component and those changes were the driving force for the differences reflected in the revised Form A-7.

The Professional Team reviewed the following corrections to be included in the revised submission to be provided by June 13, 2008.

1. G-1.5 – revised to include only changes in the model from the prior year's submission
2. G-1.6 – revised to include all changes in the model and the submission document since the original February 28, 2008 submission
3. Updated Certification Forms G-1, G-4, G-5, G-6, and G-7
4. Form A-5 – number of hurricanes corrected
5. Form S-3 – caption for Comparison #5 corrected

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the March 12, 2008 meeting. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Standard G-1, Disclosure 2 (pages 15-34)
   The disclosure calls for a "comprehensive" not "concise" summary of the model. A reader should be able to recreate the structure of the model from this summary without reference to later Standards. This is not possible with the present version as multiple references are given for the same model component and/or many salient details of the model are not given.

2. Standard G-1, Disclosure 2 (page 19)
   There is no legend for Figure 2.

3. Standard G-1, Disclosure 4 (pages 36-51)
   Many references are incomplete or incorrectly specified.

4. Form M-1 (page 98)
   Data not provided for Regions E and F.

5. Form V-1 (page 132)
   Form was incorrectly completed using a three-second gust windspeed rather than a one-minute windspeed as specified.

6. Forms V-2 and V-3 (pages 133-134)
   Entries for Wall-Foundation Strength rows are missing with no explanation provided.

7. Forms V-1, V-2, and V-3 (pages 132-134) and Forms A-1, A-2, A-3, A-4, A-5, A-6, A-7 and A-8 (pages 173-203)
   Forms not stated in italics as required in Acceptability Process on page 41 of the *Report of Activities*.

8. Standard A-7, Disclosure 2 (page 165)
   Data or documentation used to confirm or validate the method used by the model not discussed.

9. Form A-5, Part B (pages 192-193)
   Total row not provided.

10. Form A-6A.E (pages 264-341) and Form A-6B.E (pages 344-421)
    Anomaly explained in Disclosure A-10.1 (pages 170-171) not shaded.

11. Standard C-6, Disclosure 2 (page 251)
    Rules underlying the model and code revision numbering systems not described.

12. Standard M-1.A and B (page 73)
    No responses to Standard.

13. Forms A-6A and A-6B (pages 264-421)
    Forms must be resubmitted using the format provided.

14. Standard A-10, Disclosure 4 (page 171)
    Provide justification for changes.

Additional Verification Review Comments

The Professional Team reviewed the following deficiencies cited by the Commission Chair, in consultation with SBA staff and the Professional Team, on May 23, 2008. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Standard G-1, Disclosure 1 (pages 17-19)
   The revision introduces water depth as a contributor to intensity. The threat area has also been revised since the February submission. The rationale and scientific literature in support of these modeling decisions are not given.

2. Standard G-1, Disclosure 6 (pages 82-83)
   The revised Form M-1 has changed substantially, yet there is no item in the list that addresses this point. The revised landfall methodology has been revised without significant discussion.
   The error in the use of vulnerability coefficient matrices is not noted, even though it required the re-run of the output ranges and many other forms.
   The strong bias issue in modeled versus actual losses within Standard S-5 is not explicitly addressed.
   Item 6 is not explained fully here or elsewhere in the revised submission.

3. Form M-1 (pages 131-140)
   The table in the revised Form M-1 has changed substantially, but the accompanying histograms have not been updated.

4. The duplexed copy with track changes does not include much of the material that has been deleted since the initial submission.

5. Undefined icons appear as symbols or former figures (e.g., pages 317, 318).

6. Pages 248-258 are blank.

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

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

Be prepared to provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2002 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2002 FHCF exposure data. Be prepared to discuss changes in loss costs from the use of the 2007 FHCF exposure data from the loss costs produced using the 2002 FHCF exposure data.
When the Professional Team arrives on-site, provide the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

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

Trade Secret Information for review by the Professional Team (page 4):

- The source code for the loss model will be available for review by the Professional Team.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

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

2. All software located within the model, used to compile data used by the model, used to validate the model, and used to project model loss costs (1) fall within the scope of the Computer Standards, and (2) will be reviewed interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each Standard).

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

Pre-Visit Letter

1. G-1, Disclosure 2, page 18 – Clarify whether tendencies are held constant for 24 hour intervals.

2. G-1, Disclosure 2, page 20 – Identify the threshold distance between a hurricane and a Florida ZIP Code.

3. G-1, Disclosure 2, page 21 – Elaborate on the subset used for development of the Holland B pressure profile parameter.

4. G-1, Disclosure 2, page 21 – Provide details concerning the corrected anomalies in the population centroids.

5. G-1, Disclosure 2, page 21 – Provide the relevant details from Powell et al. (2005) that are not included in this overview.

6. G-1, Disclosure 2, page 21 – Provide details concerning the effects of wind-borne missiles.

7. G-1, Disclosure 2, page 21 – Provide details concerning determination of statistically significant building types in Florida.

8. G-1, Disclosure 2, page 27 – "A high concentration of claims with zero appurtenant loss and a very large scatter of loss elsewhere" describes a mixture of a discrete distribution (with mass at zero) and possibly a right skewed distribution. What

proportion of zero claims is being used? Provide details on the use of the exponential distribution for this situation.

9. G-1, Disclosure 2, page 30 – Provide details concerning the distribution determinations described in the paragraph that follows Table 4.

Verified: ~~NO~~ YES

Professional Team Comments:

An itemized description of all substantive changes must be provided (G-1.6). Completed Certification Forms G-1, G-2, G-3, G-4, G-5, G-6, and G-7 are required.

Discussed basis for using 24 hour intervals. The rate of change in intensity is held constant during the 24 hour interval. For track motion, the acceleration is held constant and the translation speed and acceleration are computed at one hour intervals based on the constant acceleration. The storm speed and angle are constantly changing over the 24 hour period.

Reviewed the damage threshold distance which ranges from 4 for large storms to approximately 10 for small storms.

Discussed the subset used for development of the Holland B pressure profile parameter. The Willoughby and Rahn (2004) data set was filtered 1) by height of flight-level pressure surface <= 700 mb, 2) by location: Longitude > 60° West and < 98° West, Latitude > 15° North and < 35° North, 3) by storm-relative flight level maximum windspeed Vmax > 67 mph, and 4) by adding surface Pmin values according to HURDAT for each mean flight level profile in the database.

Discussed the methodology for correcting anomalies in the population centroids. If any roughness element within 500 meters of the population centroid has a value below that of a low density residential neighborhood, it is set to that of a low density neighborhood. If the centroid is over water, all roughness elements within 500 meters are set to that of a low density residential neighborhood. These adjustments are done prior to computing the effective roughness.

Copy of Powell et al. (2005) paper was provided and reviewed by Professional Team.

Reviewed the effects of wind-borne missiles. Wind-borne debris is modeled by an exponential cumulative distribution function, increases the vulnerability of windows, and is more pronounced at higher windspeeds. These are separate calculations from pressure failure. Damaged openings influence internal pressure and therefore increases vulnerability of other components such as sheathing, walls, and connections.

Reviewed example of probability of missile breakage of a medium window and the use of a uniform distribution to assign a number from 0 to 1. Wind-borne missile damage does not vary on population density in the model.

Reviewed the implementation of wind-borne missiles damage determination. Each window is assigned a probability of damage from impact as a function of windspeed, window size, and wind location. A random number is drawn from the uniform distribution to determine failure from the missile. Breached windows influence loads on other components.

Reviewed classification of Florida building stock which refers to the population of single family homes in Florida. The buildings that are statistically representative are the ones that represent a large portion of the building stock. Sources of information are the Florida County Tax Appraiser's database, the FHCF exposure database, and Insurance Company portfolio files. Reviewed structural characteristics for residential homes. Reviewed results of survey in Brevard County. The different model types and their characteristics are based on the population statistics in each region and represent average homes in each region. The boundaries of the regions were defined based on the FHCF data.

Discussed difficulty of modeling appurtenant structures due to no conclusive data being available, not a significant source of insurance claims, and structural types being highly variable. The choice of distribution is meant to achieve a spread of appurtenant structure similar to the claims data. Exponential was chosen to concentrate more losses near the horizontal axis. The distribution has no influence on the model results because the model operates with the mean value. Reviewed plot of appurtenant structures loss ratio versus windspeed for high, moderate, and low vulnerability.

Discussed the distribution of ages in a region provided in Table 4. Three sets of models (weak, medium, strong) reflect different eras in building code development and practice. Reviewed model distribution by age – prior to 1970, 1970 to 1983, 1984 to 1993, and 1994 to present.

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

Reviewed the following changes made in the model:

- Minimum central pressure cutoff for storm initiation changed from 990 mb to 1005 mb resulting in an increase in category 1 storms.
- Revised threat area criteria. New threat area extends 62 miles from the coast. Storm initiation is 36 hours before landfall or, in the case of by-passing storms, 36 hours before first entering the threat area.
- Change in PDF bin aggregation for shallow/deep water. This change had the most impact on the loss costs as reflected in Form A-7. There is a reduction in the number of intense hurricanes affecting north Florida and an increase in the number of intense hurricanes affecting south Florida.

Reviewed the basis for selecting 62 miles as the cutoff distance for the threat area.

Itemized descriptions of all substantive changes were provided in response to G-1.6. Updated Certification Forms G-1, G-2, G-3, G-4, G-5, G-6, and G-7 were provided in the revised May 2008 submission.

Reviewed revised responses to G-1.5 and G-1.6 provided during the additional verification review.

Reviewed updated Certification Forms G-1, G-4, G-5, G-6, and G-7 provided during the additional verification review.

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.

Verified: YES

Professional Team Comments:

Verified that no former participants left for violation of professional ethical standards. Personnel no longer involved are PhD students that have graduated.

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 61 – Provide details and examples of ZIP Code checking by experts.

Information to be presented to the Professional Team:

- G-3.C, page 61 – Maps showing the ZIP Code boundaries and the associated centroids have previously been provided to the Professional Team in the last submission, and will be available for further review for the Professional Team for the current submission.

Verified: YES

Professional Team Comments:

Verified no changes were made to the ZIP Code database in the current submission.

Discussed process for ZIP Code verification on data provided by vendor. Reviewed ZIP Code boundary maps and associated centroids.

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:

Unable to verify until all other Standards are verified.

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

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

G-5 Editorial Compliance*

*(*New Standard)*

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

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2007*.

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

3. Demonstrate that the modeler submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and error free regarding the inclusion of extraneous data or materials. Form G-7 will be reviewed.

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

Professional Team Comments:

Unable to verify until all revisions to the submission have been reviewed.

Discussed with Steve Cocke his process for editorial review.

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

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

Additional editorial items noted by the Professional Team were satisfactorily addressed during the additional verification review. The Professional Team cannot guarantee that all editorial difficulties were identified. The modeler is responsible for eliminating such errors.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 1, 2007 (or later), HURDAT as of June 1, 2005 plus the 2005 and 2006 seasons, or HURDAT as of June 1, 2006 plus the 2006 season. Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

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

Audit

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

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

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

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

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

Pre-Visit Letter

19. Form M-1, page 100 – The "observed" values are the frequencies from the historical record, while the modeled values are the "expected." The values in Table 6 appear to be reversed. Be prepared to discuss the chi-square analysis for this table.

Verified: ~~NO~~ YES

Professional Team Comments:

Differences between modeled and historical values raise concern that there is a statewide bias and consequent regional biases in stochastic landfalls. Discussions on the quality of the historical database raised some questions presently being explored, but not yet in the peer-reviewed scientific literature. Exploration of the stochastic storm landfall distribution by region was not elucidated.

Discussed modifications by the modeler to the Base Hurricane Storm Set which included modifications to at least three storms (Erin 1995, Irene 1999, Opal 1995 all reduced by one category at landfall; these adjustments were made based on peer-reviewed research as documented in Powell and Aberson (2001).

Confirmed that no differential weighting or partitions were used in developing the historical landfall frequency by category.

Discussed the methodology for modeling landfall occurrence and the differences in modeled landfall frequency versus historical.

Discussed the uncertainty in the historical counts related to inconsistencies in storm categorization in HURDAT as a possible basis for the difference in the frequency counts.

Discussed a comparison of hypothetical loss costs that used historical tracks from HURDAT.

Discussed the development of the stochastic set based on HURDAT. For the purposes of genesis location, storms are only counted if they are below 990 mb and in the threat area.

Confirmed that Rmax and B are the same in the model as in the previous submission.

Reviewed comparison of Form M-1 and S-4 results.

Reviewed results provided in Form M-1. Discussed the results of Chi square tests and associated p-values. A corrected Table 6 will be provided in the revised submission to correct expected and observed values and to combine bins with <5 counts but >10% of the total.

Reviewed revised historical results provided in a revised Form M-1. Reviewed Chi square tests on scaled historical counts based on the modeler's own previous submission.

Discussed potential sensitivity analyses of impact of threat area choice on landfall frequencies.

Discussed the criteria used for retaining "genesis" locations in the threat area: either (1) the storm had made landfall as a hurricane in Florida or adjacent states and landfall time minus 36 hours defined genesis location; or (2) had Pmin less than 990 mb in threat area (no requirement on landfall).

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

Reviewed the following changes made in the meteorological component of the model:

- Minimum central pressure cutoff for storm initiation changed from 990 mb to 1005 mb resulting in an increase in category 1 storms.
- Revised threat area criteria. New threat area extends 62 miles from the coast. Storm initiation is 36 hours before landfall or, in the case of by-passing storms, 36 hours before first entering the threat area. The threat area change had a minimal impact on hurricane landfall frequencies.
- Change in PDF bin aggregation for shallow/deep water. This change had the most impact on the loss costs as reflected in Form A-7. There is a reduction in the number of intense hurricanes affecting north Florida and an increase in the number of intense hurricanes affecting south Florida.

Reviewed the basis for selecting 62 miles as the cutoff distance for the threat area.

Reviewed the use of water depth as a proxy for oceanic heat content in intensity changes. Reviewed maps of ocean heat content for Hurricane Katrina and other time periods.

Reviewed changes in Form M-1:

- No changes were made to the historical counts
- Change in minimum pressure criterion added more category 1 storms
- Changed criterion for counting landfalls in the Florida Keys
    - Landfall if Key is within Rmax distance of storm center

The changes resulted in 5 additional hurricanes for a 107 year period statewide.

Reviewed chi-square test results for Florida by region on the landfall counts.

M-2 Hurricane Parameters and Characteristics*

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

11. M-2, Disclosure 1, page 76 – Describe how the 0.815 reduction in Rmax relates to the 10% multiplier for Rmax discussed under Disclosure 2 on page 77. Is the 0.815 reduction on B directly (as implied at the end of the paragraph)?

12. M-2, Disclosure 5, page 80 – Discuss the choice of a 450 m over-water boundary layer depth in the context of boundary layer jets in hurricanes.

13. M-2, Disclosure 11, pages 82 – Discuss the reasoning underlying holding the roughness length constant over-land in the slab model. Discuss how the land use/land cover data is incorporated into the surface roughness calculation.

Verified: YES

Professional Team Comments:

Discussed the 0.815 reduction in Rmax which is confined to adjustment of the 700 mb flight-level Rmax values in the Willoughby and Rahn (2004) dataset. The 700 mb flight-level Rmax values are adjusted to surface Rmax values relevant to the development of the Holland B model.

The 10% bias reduction in Rmax is independent of the adjustment to the Willoughby and Rahn data and is caused by a small outward bias in the windfield solution on the 0.1 R/Rmax resolution grid.

Discussed the 450 m over-water boundary layer depth that is consistent with the observed height of the maximum wind in the boundary layer, sometimes referred to as the "boundary layer jet." Reviewed histogram on differences between the open terrain surface winds at 10 m from 450 m to 1 km showing a slight increase in winds by assuring a 1 km boundary layer depth.

Confirmed no changes were made to the roughness database in the current submission.

Discussed the choice of a constant roughness over land for the windfield model being for computational efficiency. The model computes an open terrain wind, which is then adjusted to an actual terrain windspeed according to the spatial distribution of roughness (determined from land use/land cover data) at the particular ZIP Code depending on wind direction.

Discussed the methodology for incorporating the land use/land cover data into the surface roughness calculations. Land cover classifications from MRLC NLCD 2001, gridded at 30 m resolution, are converted to typical roughness values associated with the land cover using a lookup table. There are approximately 25 different land cover classifications and the roughness values were primarily derived through research efforts of HAZUS. A copy of the Hazus MR-3 Technical Manual, 2006 was provided and reviewed by the Professional Team. After the roughness values are obtained, the effective roughness is computed at each ZIP Code centroid. The effective roughness model takes into account the fetch by using an exponential weighting function as a function of the distance of each roughness element to the ZIP Code centroid.

Corrections to low (e.g., lake, open terrain) roughness values are made for all locations within 500 m of the centroid. These roughness values are adjusted up to low-density housing values.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

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

Audit

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

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

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

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

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

Professional Team Comments:

Unable to verify as a result of landfall frequency discrepancies. (See Standard M-1.)

Discussed the process for selecting stochastic storm tracks. Every track that comes close to Florida has a weighting of one.

Verified strike intervals are not used.

Discussed how initial storm genesis is derived from HURDAT (see Standard M-1). Motion change and intensity tendency pdfs are empirically derived.

Reviewed computer code for generating the initial position of the storm, for adding random error term to initial location, and for calculating relative intensity.

Discussed the calculations for time evolution of the stochastic storm tracks and intensity.

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

Reviewed modified storm track model and threat area definition.

Reviewed the basis of the partition of the intensity change PDFs using water depth criteria.

M-4 Hurricane Windfield Structure*

*(*New Standard)*

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

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

Audit

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

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

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

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

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

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

7. Form M-2 will be reviewed.

Pre-Visit Letter

14. M-4.A, page 85 – Discuss the use of H*Wind for validation of over-land wind speeds. Are H*Wind values calculated for marine exposures? If so, what additional information was used for over-land wind speed validation?

15. M-4.B, page 85 – Provide details of aerial photography surface roughness studies and methods used to incorporate this information in the model.

16. M-4, Disclosure 1, page 86 – Justify the 982 mb value in the caption of Figure 9 given the definition of DelP.

17. M-4, Disclosure 1, page 86 – Provide examples of wind radii corresponding to five different (Vmax, Rmax) combinations for both the largest and smallest B parameter used for the stochastic storm windfield, demonstrating consistency of wind radii with Form M-3.

Verified: YES

Professional Team Comments:

Discussed Figure 9 and the values provided in the caption. A corrected Figure 9 will be provided in the revised submission.

Discussed the results provided in Form M-2. The higher windspeed in NE Florida was attributed to Hurricane Gladys (1968), change in the speed of the storm accelerating and strengthening based on information provided in Monthly Weather Review. The higher windspeed in the NW Florida panhandle was attributed to Hurricane Dennis (2005). Impact of an individual storm on a ZIP Code is dependent on the relative location of the storm Rmax to the ZIP Code centroid.

Reviewed radial profiles of rotational winds for typical values of windfield parameters.

Discussed the use of H*Wind for validation of over-land windspeeds. Over-land observations are integrated within the H*Wind analysis together with marine observations. All modeled winds at all ZIP Code centroids were adjusted to marine exposure. Marine exposure was chosen since the H*Wind marine gridded fields were already available as a standard product for constructing wind swaths.

Reviewed examples of open terrain swath validation for Hurricane Andrew.

Reviewed the methodology for determining the roughness classification table from the HAZUS MR-3 Technical Manual, including validation using aerial photography and site visits. New classifications were added in the 2001 MRLC National Land Cover database. For the new classifications, example photographic site images from NOAA's Coastal Services Center were used to estimate roughness based on field experience evaluating roughness from weather station site visits and aerial/satellite imagery for post-storm hurricane windfield reconstruction.

Reviewed examples of wind radii. Wind radii are not readily calculated from the windfield model. Form M-3 was based on interpolating ZIP Code winds and locations relative to the storm center. Additional analyses were presented confirming cases of 110 mph wind radii for storms with 970 mb Pmin.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

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

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

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

Saffir-Simpson Hurricane Scale:

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

Audit

1. Describe the variation in over-land decay rates used in the model.
2. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.
3. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed.

Pre-Visit Letter

18. M-5, Disclosure 2, page 93 – Discuss the results provided in Figure 13 for Hurricanes Charley and Frances.

Verified: YES

Professional Team Comments:

Reviewed the results for Hurricane Charley (2004) and Hurricane Frances (2004) in Figure 13.

For Hurricane Charley (2004), at time zero (1.5 hours before landfall), the modeled maximum winds for marine exposure are higher than observed, but shortly after landfall the maximum windspeeds for open terrain agree. At the time of the intermediate analysis, approximately 6 hours after landfall, the model overestimates the open terrain windspeed. Just before exiting the coast, approximately 9 hours after landfall with a Pmin of 982 mb, the maximum winds are found over water and the marine wind from the model exceeds the observed value by over 20 mph. By the time Hurricane Charley (2004) exits land, the pressure has risen to 993 mb and the modeled maximum marine winds nearly match the observed maximum marine exposure windspeed. Every pair in Figure 13 is at the same location, same exposure.

For Hurricane Frances (2004), at first the model is under-estimating the winds, but after landfall, the winds are matching up very close to the H*wind analyses. A discrepancy was detected in the choice of wind exposures for some of the model/observation data pairs plotted in the submission. A corrected plot will be provided in the revised submission.

M-6 Logical Relationships of Hurricane Characteristics

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

B. The mean windspeed shall decrease with increasing surface roughness (friction), all other factors held constant.

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed Form M-3.

Discussed no dependence on Pmin and use of a gamma distribution to model Rmax.

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 windspeed that generates damage shall be reasonable.

Audit

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

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

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

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

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

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

7. Form V-1 will be reviewed.

Pre-Visit Letter

20. V-1.D, page 114 – Provide and discuss "detailed exposure study."

21. V-1, Disclosure 5, pages 126-127 – Provide explicit vulnerability functions for frame and masonry structures in St. Johns, Monroe, and Flagler counties.

Verified: YES

Professional Team Comments:

Reviewed corrected Form V-1 using one-minute sustained windspeeds as specified. The model computes the damage based on three-second gusts which are then converted into one-minute sustained winds.

Discussed the results being approximately the same in both versions of Form V-1. The original Form V-1 using three-second gusts was plotted using actual terrain and the revised Form V-1 using one-minute sustained winds was plotted using open terrain.

Converting the revised Form V-1 values to actual terrain resulted in similar results in the Form.

Reviewed corrected plot of the building damage ratio versus windspeed. The variation in the revised Figure 32 is due to the process of conversion and re-aggregation.

Reviewed site inspection field notes for 2004 hurricanes. Reviewed report documenting the methodology and results of the ongoing study of the performance of residential structures in the State of Florida.

Documentation reviewed:

Post 2004 Hurricane Field Survey – an Evaluation of the Relative Performance of the Standard Building Code and the Florida Building Code, Structures Research Communication No. 53102-2, UF Project No. 00053102, Final Report, March, 2006,

Principal Investigator Kurtis Gurley, Associate Professor, University of Florida, Department of Civil and Coastal Engineering, Project Manager Rick Dixon, and Sponsor Florida Building Commission, Florida Department of Community Affairs.

Reviewed detailed exposure study.

Reviewed vulnerability curves for frame and masonry structures in St. Johns, Monroe, and Flagler counties.

Verified no new reports or historical data were incorporated into the model or used in validation of the model.

Reviewed process and computer code for converting MATLAB vulnerability matrices into user friendly Excel data format.

Discussed total probabilities of damage by windspeed exceeding 1.0 for matrix columns. Reviewed procedures taken in response to this problem in 2007. Confirmed that one of the resultant changed vulnerability functions had not been used to generate this submission. (See Standard A-10).

Confirmed that these adjustments to the vulnerability functions did not affect Form V-1.

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

Verified that all revisions, additions, and corrections to the original February 2008 submission had no effect on the vulnerability functions or any of the vulnerability Forms (V-1, V-2 and V-3).

No individual vulnerability functions were changed, but initially incorrect combinations and weights of these functions resulted in errors in other parts of the original February 2008 submission which were corrected.

V-2 Mitigation Measures

A. Modeling of mitigation measures to improve a structure's wind resistance and the corresponding effects on vulnerability shall be theoretically sound. These measures shall include fixtures or construction techniques that enhance:

- ***Roof strength***
- ***Roof covering performance***
- ***Roof-to-wall strength***
- ***Wall-to-floor-to-foundation strength***
- ***Opening protection***
- ***Window, door, and skylight strength.***

B. Application of mitigation measures shall be empirically justified both individually and in combination.

Audit

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

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

3. Mitigation measures used by the model that are not listed as required in this Standard will be disclosed and shown to be theoretically sound and reasonable.

Pre-Visit Letter

22. V-2, Disclosure 3, pages 130-131 – Provide an example of mitigation implementation.

23. Form V-2, page 133 – Explain negative values.

24. Form V-3, page 134 – Discuss the increase in "Mean Damage Ratio" from the previous submission.

25. Form V-3, pages 135-136 – Define Structures 1 and 2 in Figures 33 and 34.

Verified: YES

Professional Team Comments:

Discussed implementation of mitigation in the model.

Reviewed results provided in Form V-2. Discussed that the negative values are from round off of smaller values within the uncertainty scatter of the model and indicate zero change. Another factor is the failure of adjacent components or units of components at lower windspeeds which negate the mitigation effect of other stronger components.

Reviewed results provided in Form V-3 and the increase in “Mean Damage Ratio” from the previous year’s final submission due to changing from three-second to one-minute windspeeds. Reviewed plot of vulnerability curves for the reference masonry structure of actual terrain three-second gust windspeeds and actual terrain one-minute sustained windspeeds. Revised Figures 33 and 34 will be provided to the Commission.

Reviewed Excel files used to calculate and fill in the values in Form V-2 and Form V-3. Tested for consistency between these Forms.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs

Modeled loss costs shall reflect all damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no model changes.

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

Reviewed revised storm track model. Confirmed that treatment of by-passing storms is consistent with Standard A-1.

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.

Pre-Visit Letter

26. A-2.A, pages 138-139 – Have available insurance company data used in the development or validation of the model.

Verified: YES

Professional Team Comments:

Discussed the review and testing of the validation insurance data completed last year.

Discussed actions taken when observations in the company data might present problems in validation. One insurer input issue was related to the removal of duplicates.

Discussed insurance company claims data received and the quality of the data. 2004 claims data was received from 21 insurance companies for Hurricanes Charley, Frances, Ivan, and Jeanne. Problems were encountered due to a lack of consistency in the data. Discussed and reviewed correspondence with companies on clarification of the data and the assumptions made when no responses or inadequate responses were received. Communication was direct with Citizens Property Insurance Corporation; otherwise company communications went through the Office of Insurance Regulation.

Reviewed plots of masonry structure losses versus windspeed for Hurricane Jeanne (2004), Hurricane Frances (2004), and Hurricane Charley (2004) indicating the lack of consistency in the claims data.

Reviewed methods used to deal with inconsistencies.

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

Reviewed validation results from new insurance data from several insurance companies as well as corrections to some previous validation comparisons.

A-3 Loss Cost Projections

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

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

Audit

1. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, and economic inflation.

Verified: YES

Professional Team Comments:

Model loss costs are based on engineering studies and insurance loss data, exclusive of prohibited items.

A-4 Demand Surge

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

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

Audit

1. Provide the data and methods used to determine the effects of demand surge.

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

Pre-Visit Letter

27. A-4, pages 145-148 – Describe and provide examples of studies or analyses performed using data from 2004 or later storms to validate the demand surge functions and calculations.

Verified: YES

Professional Team Comments:

Reviewed analyses conducted for demand surge validation that included looking at actual versus modeled losses for Hurricane Frances (2004) and Hurricane Charley (2004). The analysis looked at the gap between the actual and modeled losses and how much of the gap could be explained by the demand surge factor. Determined small percentage of the gap was due to demand surge.

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

A-5 User Inputs

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

Audit

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

2. All insurer inputs and assumptions will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the process for reviewing and cleaning new data received from insurance companies. Reviewed how the new FHCF exposure data was processed. All commercial exposure was deleted, construction type 12 was deleted, condominiums were set to construction type other. Discussed assumptions made with different anomalies in the exposure data.

Verified appropriate ingestion of FHCF exposure data for selected categories and multiple exposures.

Reviewed computer code for mapping construction types in the Industry Tech Guide used to map the FHCF exposure data into the model.

Reviewed computer code for mapping fields in FHCF exposure data with a zero risk count.

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

28. Form A-3, pages 176-178 – Explain large increases in “Loss” numbers from previous submission.

29. Form A-4, pages 179-190 – Explain large increases in “Total Loss” numbers from previous submission.

30. Form A-5, pages 192-193 – Discuss the increase in “Number of Hurricanes” for each of the Ranges.

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

Professional Team Comments:

Standard not met due to necessity to revise Forms impacted by the problems discovered during the audit.

Reviewed Form A-3 and the increase in losses for historical storms attributed to the significant increase in the 2007 FHCF exposure data from the 2002 FHCF exposure data.

Reviewed Form A-4 and the 70% increase in Hurricane Andrew losses.

Reviewed Form A-5 and the increase in "Number of Hurricanes" attributed to the higher exposure leading to more intense events and a resulting downward shift.

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

Reviewed results provided in revised Forms A-3, A-4, A-5, and A-7.

A-7 Deductibles and Policy Limits

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

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

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

Audit

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

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

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

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

Verified: YES

Professional Team Comments:

Reviewed calculations of loss elimination ratios which revealed problems noted elsewhere in this report.

Reviewed relationships among various deductibles.

Reviewed specific loss elimination ratio calculations for Miami-Dade and Duval counties.

Confirmed that large percentage changes in loss elimination ratios reviewed derived from low loss counties.

A-8 Contents

A. The methods used in the development of contents loss costs shall be actuarially sound.

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

Audit

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

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

3. Justify changes from the prior submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Verified: YES

Professional Team Comments:

Verified no change in calculation methods for contents loss costs from previous submission.

A-9 Additional Living Expense (ALE)

A. The methods used in the development of ALE loss costs shall be actuarially sound.

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

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

D. ALE loss costs produced by the model shall appropriately consider ALE claims arising from damage to the infrastructure.

Audit

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for ALE coverage. Documentation and justification of the following will be reviewed:
    a. The method of derivation and data on which the ALE vulnerability function is based;
    b. Validation data specifically applicable to ALE;
    c. Assumptions regarding the coding of ALE losses by insurers;
    d. The effects of demand surge on ALE for Hurricane Andrew;
    e. Assumptions regarding the variability of ALE by size of property;
    f. Statewide application of ALE assumptions;
    g. Assumptions regarding ALE for mobile homes, tenants, and condo unit owners exposure;
    h. The methods used to incorporate the estimated time required to repair or replace the property;
    i. The methodology and available validation for determining the extent of infrastructure damage and its effect on ALE costs.

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

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

Verified: YES

Professional Team Comments:

Verified no change in calculation methods for ALE loss costs from previous submission.

A-10 Output Ranges

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

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

1. masonry construction versus frame construction,

2. residential risk exposure versus mobile home risk exposure,

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

4. in general, northern counties versus southern counties.

Audit

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

2. The modeler will be required to justify all changes from the prior submission using the 2002 Florida Hurricane Catastrophe Fund aggregate exposure data.

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

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

Pre-Visit Letter

31. Forms A-6A and A-6B, pages 264-421 – Justify the weighted average $0 deductible loss costs for personal residential owners frame and owners masonry for Monroe and St. Johns counties.

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

Professional Team Comments:

Discovered inaccuracies in the process used to incorporate vulnerability matrices in calculation of output ranges. Standard not met due to necessity to revise Forms A-6A, A-6B, A-7, and A-8 impacted by the problems discovered during the audit.

Reviewed output range results for Monroe and St. Johns counties.

For Monroe County at the ZIP Code level, frame is greater than masonry, however, at the weighted average level frame is less than masonry.

For St. Johns County at the ZIP Code level, frame is greater than masonry and at the weighted average level using the 2002 FHCF weights, frame is greater than masonry; however, at the weighted average level using 2007 FHCF weights, frame is less than masonry.

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

Reviewed in detail the changes in loss costs reflected in the revised Form A-7.

The increase in loss costs for structure masonry for South and Coastal attributed to structures in the South being predominantly masonry. New storm track model resulted in more intense storms in Region B (southwest).

After the initial on-site review, two problems with the implementation of the vulnerability matrices were discovered. The first problem arose from format conversions of the vulnerability matrices leading to rounding errors. Use of an alternative conversion method corrected this error. The second problem resulted from incorrect combinations of the base vulnerability functions. This problem was evident for northern mobile homes in the original February 2008 submission. A new methodology has been implemented (see Standard C-4) to avoid repetition of this error.

Reviewed in detail the combined mobile home vulnerability matrix (using varying ages) and the process for implementing vulnerability matrices in the model.

Reviewed the changes in the loss costs resulting from the changes in the meteorological component and the use of the correct vulnerability matrix for mobile home in northern counties.

Reviewed the differences in the loss costs for each deductible level, particularly between $1000 and $2500 or between 2% and 5% attributed to the severity of storms dominating the frequency of storms.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods in the appropriate disciplines.

Audit

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

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

Pre-Visit Letter

32. S-1, Disclosure 1, page 206 – Clarify if this is a *new* Rmax model compared to version 2.6.

33. S-1, Disclosure 5, page 215 – Explain the relevance in the confidence interval for the "true CV."

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

Professional Team Comments:

A persistent approach to checking for agreement between modeled and historical losses is correlation analysis even though the conclusion may be substantially driven by a single outlying point. Goodness of fit tests (chi square tests typically) are interpreted as providing "good" fits when in fact the interpretation should be that there is lack of evidence of a poor fit (see the *Report of Activities*, page 140). Chi square tests should also report the degrees of freedom to account for the number of bins and the number of estimated parameters. The response to this Standard contains numerous typographical errors, inconsistencies and ambiguous wordings (e.g., p-value, P-value, County wise for Company A, and others).

Verified no changes in the Rmax model from the previous submission. A revised page 206 removing "new" as it relates to the Rmax model will be provided in the revised submission.

Discussed gamma distribution for the stochastic model.

Reviewed results in Form S-1 and the two storms that were added.

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

Reviewed the complete set of goodness-of-fit tests with adjustments made since the previous on-site review.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Same material as last year.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Same material as last year.

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.

Pre-Visit Letter

34. S-4, Disclosure 1, page 225 – Explain the relevance of the *optimal* number of simulations of interest.

Verified: YES

Professional Team Comments:

Reviewed Excel spreadsheet for 50,000 simulations showing average loss, standard deviation, number of years in county where storms made landfall, and standard errors by county.

Reviewed computer code that takes output from the model and produces the numbers viewed in the spreadsheet, code that aggregates the data by county, code that prints the final output results for Standard S-4, code that calculates the standard deviation, and exception code for verification of the output.

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

Reviewed the increase in simulation size from 50,000 to 53,500 (500 replications of 107 years of simulation).

S-5 Replication of Known Hurricane Losses

The model shall estimate incurred losses in an unbiased manner on a sufficient body of past hurricane events from more than one company, including the most current data available to the modeler. This Standard applies separately to personal residential and, to the extent data are available, to mobile homes. Personal residential experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail.

Audit

1. The following information for each insurer and hurricane will be reviewed:
   a. The validity of the model assessed by comparing expected losses produced by the model to actual observed losses incurred by insurers at both the state and county level,
   b. The version of the model used to calculate modeled losses for each hurricane provided,
   c. A general description of the data and its source,
   d. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
   e. The date of the exposures used for modeling and the date of the hurricane,
   f. An explanation of differences in the actual and modeled hurricane parameters,
   g. A listing of the departures, if any, in the windfield applied to a particular hurricane for the purpose of validation and the windfield used in the model under consideration,
   h. The type of property used in each hurricane to address:
      i. Personal versus commercial
      ii. Residential structures
      iii. Mobile homes
      iv. Condominiums
      v. Structures only
      vi. Contents only,
   i. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.

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

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

4. Form S-3 will be reviewed.

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

Pre-Visit Letter

35. S-5, Disclosure 1, page 227 – Discuss the design and implementation of the methods and code used to create the values in Table 19.

36. S-5, Disclosure 1, page 228 – Figures 64 and 65 indicate that generally the actual losses are larger than the modeled losses. The discussion on page 227 argues that there is reasonable agreement between the two sets. Be prepared to discuss this seemingly contradictory material in depth.

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

Professional Team Comments:

The response to the Standard asserts that Table 19 compares the modeled and actual total losses by hurricane and company, when in actuality, the Table merely lists the exposure, the actual loss and modeled loss for 31 combinations of companies and events. Subsequently, the agreement between observed and modeled losses was argued on the basis of a correlation analysis which ignores the question of bias as mandated by the Standard. The Table lists an exposure value contrary to the correct value given during the audit, four events are listed with non-standard hurricane names, and the company names given for the final six events are evidently not disguised.

In the revised disclosure 1 response, all previous text was removed. The previous analysis concerned the first 25 entries in Table 19 of which 22 had larger actual than modeled losses. Several statistical analyses were provided which attempted to support the lack of bias in spite of the visual evidence in Figure 65. The modeler confirmed that the "selected" hurricanes and companies represent all data presently available for addressing this Standard.

In the revised text, a paired t test was used "to test the equality of two population means." This wording suggests that there is a population mean associated with actual losses and one with modeled losses. In point of fact, the paired t test could be used to test whether the difference in paired mean values equals zero, with the caveat that orders of magnitude differences exist in the pairs of actual and modeled differences. The paired t test is more relevant than the correlation analysis, although the possibility must be checked whether a limited number of positive differences counterbalance many more differences of the opposite sign. The precise values of the test statistic and p value reported were not able to be verified. The bootstrap confidence interval provided adds no apparent value.

The loss information from the additional six storms in the revised material suggests that the bias may be less substantial than in the original submission. The revised pages of S-5 are not in appropriate track changes form from the original February 28, 2008 submission.

Reviewed values provided in Table 19. Revised Table will be provided with correct values for Hurricane Charley, Company D. Discussed process for completing Table 19 and how only one cell could be incorrect. Reviewed actual output file produced by the model where the numbers are taken to produce Table 19.

Reviewed scatter plot provided in Figure 65. Reviewed the statistical analysis completed on actual versus modeled losses. Reviewed results of independent t tests, Kolmogorov-Smirnov tests and the associated p-values. Figure 65 shows clear evident that the modeled losses are lower than the actual losses

Discussed insurance company claims data received and the quality of the data. 2004 claims data was received from 21 insurance companies for Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), and Hurricane Jeanne (2004). Problems were encountered due to a lack of consistency in the data. Discussed correspondence with companies on clarification of the data and the assumptions made when no responses or inadequate responses were received. In some cases communication was dealt directly with the company while others went through the Office of Insurance Regulation.

Reviewed plots of masonry structure losses versus windspeed for Hurricane Jeanne (2004), Hurricane Frances (2004), and Hurricane Charley (2004) showing the lack of consistency in the claims data.

Reviewed plots showing improvement in the model where they were grossly underestimating in version 1.5 to a better fit with the new version 2.6/2.7 windfield model. New analyses showed structure damage was underestimated, contents damage was overestimated, and appurtenant structures and ALE damages were underestimated.

Discussed FIU's solution of increasing structure damage at low to moderate windspeeds and decreasing at high windspeeds, decreasing contents damage, and increasing appurtenant and ALE damage.

Reviewed paired t tests on actual versus modeled losses with 30 points which exclude Hurricane Andrew (1992).

Reviewed results of parametric and non-parametric approaches.

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

Reviewed additional validation analyses performed since the original February 2008 submission.

- The validation set in the February 2008 submission (version 2.7) consisted of 25 company/hurricane portfolios.
- The validation set in the May 15, 2008 revised submission (3.0) consisted of 31 company/hurricane portfolios.
- The validation set provided with the responses to the deficiencies on May 29, 2008 consisted of 39 company/hurricane portfolios.

- Since the February 2008 submission, 16 new company/hurricane portfolios were processed and added and 4 company/hurricane portfolios from the February 2008 submission were consolidated into 2 portfolios.

Reviewed changes/corrections made to previous company/hurricane portfolios after additional consideration of portfolio characteristics.

Reviewed the changes reflected in the revised Table 19 for actual losses.

Reviewed scatter plot of actual versus modeled losses for all 39 data points corresponding to company/hurricane portfolios. With the latest values in Table 19 there is no evidence of bias in modeled versus actual losses. Reviewed concordance correlation coefficients.

Reviewed other data sets not yet completely processed due to problems with the data files and time constraints. Discussed their plan for obtaining 2005 claims data for analysis and inclusion in the next model submission. Discussed limited ability to obtain clarifying or accurate data from companies with problems in their 2004 claims data.

Reviewed results provided in revised Form S-3.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-4 will be reviewed.

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

Verified: YES

Professional Team Comments:

Reviewed values in Form S-4.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

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

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

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

Audit

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

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

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

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

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

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

7. Trace the model changes specified in Standard G-1, Disclosures 5 and 6 through all Computer Standards.

Verified: YES

Professional Team Comments:

Reviewed the following documentation updates in the Primary Document Binder:

- Storm Track Model – updated the corresponding chapter in the Primary Document Binder with description of pressure decay and threat area and with a glossary table that maps variables in the code to equations in the documentation
- Wind Speed Correction – updated the corresponding chapter in the Primary Document Binder with a glossary table that maps variables in the code to equations in the documentation and updated the roughness section with more description and flowchart and class diagrams
- Wind Speed Probability – updated the corresponding chapter in the Primary Document Binder with a glossary table that maps variables in the code to equations in the documentation
- Monte Carlo Simulation – updated the corresponding chapter in the Primary Document Binder with a glossary table that maps variables in the code to algorithms in the documentation
- Vulnerability and Fragility for Residential and Manufactured Homes component – updated the corresponding chapter in the Primary Document Binder with a glossary table that maps variables in the code to equations in the documentation
- Updated rules underlying the model version and numbering system

Verified that based on Standard S-4 results of a 10,700-year run, a 50,000-year simulation was performed and all related forms and maps were re-ran for submission purposes.

Reviewed the Florida Public Hurricane Loss Model Release 2.7 Primary Document Binder, including:

- FPHLM Architecture
- Storm Forecast Module
- Windfield Module
- Damage Estimation Module
- Insurance Estimation Module
- Database Document
- Quality Assurance
- Security
- System Hardware & Software Configuration
- Testing Team Training Plan

Reviewed Table documenting each item listed in Standard G-1.5 as indicated by Audit #6.

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

Reviewed the following documentation:

- Vulnerability matrix checking program
- Primary Document Binder V3.0
- FPHLM Test Report V3.0

Reviewed new procedure for specifying the last-date modified for model component and testing documentation.

C-2 Requirements

The modeler shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component.

Audit

1. Provide confirmation that a complete set of requirements for each software component, as well as for each database or data file accessed by a component, has been maintained and documented.

Verified: YES

Professional Team Comments:

Verified no change to the set of requirements.

C-3 Model Architecture and Component Design

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

Audit

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

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

Information to be presented to the Professional Team:

- C-3, page 242 – These documents will be made available to the Professional Team during its site visit.

Verified: YES

Professional Team Comments:

Reviewed the Oracle database with latest HURDAT data which covers through to the 2006 storms.

Reviewed the update to the roughness section in the Primary Document Binder containing flowcharts and diagrams.

Reviewed the update to the class diagrams in the Primary Document Binder for the insurance loss module.

Reviewed storm track model flowchart.

Reviewed the class diagram for the storm forecast module.

Reviewed schema for Oracle databases.

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

Reviewed the flowcharts for the vulnerability matrix checking program.

C-4 Implementation

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

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

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

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

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

F. The modeler shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosures 5 and 6:

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

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

Audit

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

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

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

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

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

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

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

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

Information to be presented to the Professional Team:

- C-4.D, page 243 – The FPHLM primary document binder includes a table that gives the above requested information. The table is available for review by the professional team.

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

Professional Team Comments:

Unable to verify based on changes to be made to the implementation in response to model modifications to be performed while addressing problems discovered during the audit.

Reviewed the following glossary tables that map variables in the code to equations in the documentation:

- Storm track model
- Wind speed correction
- Wind speed probability
- Vulnerability and Fragility for Residential and Manufactured Homes

Reviewed the glossary table for Monte Carlo Simulation that maps variables in the code to equations and formulas in the documentation.

Verified the insurance loss model was modified as follows:

- incorporated exceptions in the program code to handle abnormal conditions
- modified statements that test the existence of files to use a function provided by boost library
- modified PILM program to output losses with additional decimal points
- calculated new regional-weighted demand surge factors for PILM because of the new stochastic storm set
- updated the code that creates the hypothetical exposures files of Forms A-6A and A-6B to apply the percentage deductibles to Contents Limit for

condominium-owner policies and print out the ZIP Codes of A-6A.C, A-6A.D, A-6B.C, and A-6B.D.
- added modification history and comments to the program codes
- added glossary tables in the Primary Document Binder that map variables in the code to equations and algorithms in the documentation
- updated the line counts table in the Primary Document Binder.

Confirmed that none of the insurance loss model modifications impacted the loss costs.

Verified Form M-1's code was migrated from C to C++ and modified to include the approaches of counting storm landfalls of the 2006 and 2007 Report of Activities. Verified the associated Testing Report section was updated.

Verified update of the Oracle database with latest HURDAT data which covers the storms of 2006.

Reviewed 10,700-year and 50,000-year simulation results.

Reviewed the storm track implementation, including the genPDF and StormGen Fortran modules.

Reviewed a sample storm track output calculation for Hurricane Andrew (1992).

Reviewed the variable glossary for the storm track implementation.

Reviewed the Fortran code used to determine pressure from relative intensity.

Reviewed code used to fill out Form S-4 and to perform exception handling based on file existence.

Reviewed the C++ code used for populating the Excel spreadsheets.

Reviewed Excel calculations to compute loss elimination ratios (LERs) for Miami-Dade and Duval counties, along with statewide results.

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

Reviewed the MATLAB matrix checking program used to generate the vulnerability curves. Reviewed the Java program used to cross-verify the MATLAB program.

Reviewed the modified equation table associated with the modified storm intensity change formulas.

Reviewed the Poisson distribution code implemented for Form A-5.

C-5 Verification

A. General

For each component, the modeler shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeler personnel other than the original component developers.

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.

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

Professional Team Comments:

Unable to verify based on changes to be made to testing and verification in response to model modifications to be performed while addressing problems discovered during the audit.

Verified the use of independent testing and verification.

Verified testing of roughness program was added to the Testing Report.

Verified unit, aggregation, and regression testing for insurance loss module and the update to the corresponding chapter in the Testing Report.

Reviewed data validation and cleaning process for the 2007 FHCF exposure data, using the Access query language and C++ code.

Verified that the error in Table 19 (page 227) was corrected on-site.

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

Reviewed the component verification tests used for the vulnerability matrix checking procedure.

C-6 Model Maintenance and Revision

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

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

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

Audit

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

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

Information to be presented to the Professional Team:

- C-6.1, page 251 – The detailed information will be made available to the Professional Team during its site visit.

Verified: YES

Professional Team Comments:

Reviewed the method used to define model major and minor version numbers based on changes to the meteorology, vulnerability, and actuarial components.

Reviewed CVS setup for version 2.7.

C-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no change to security procedures from the prior year's submission.