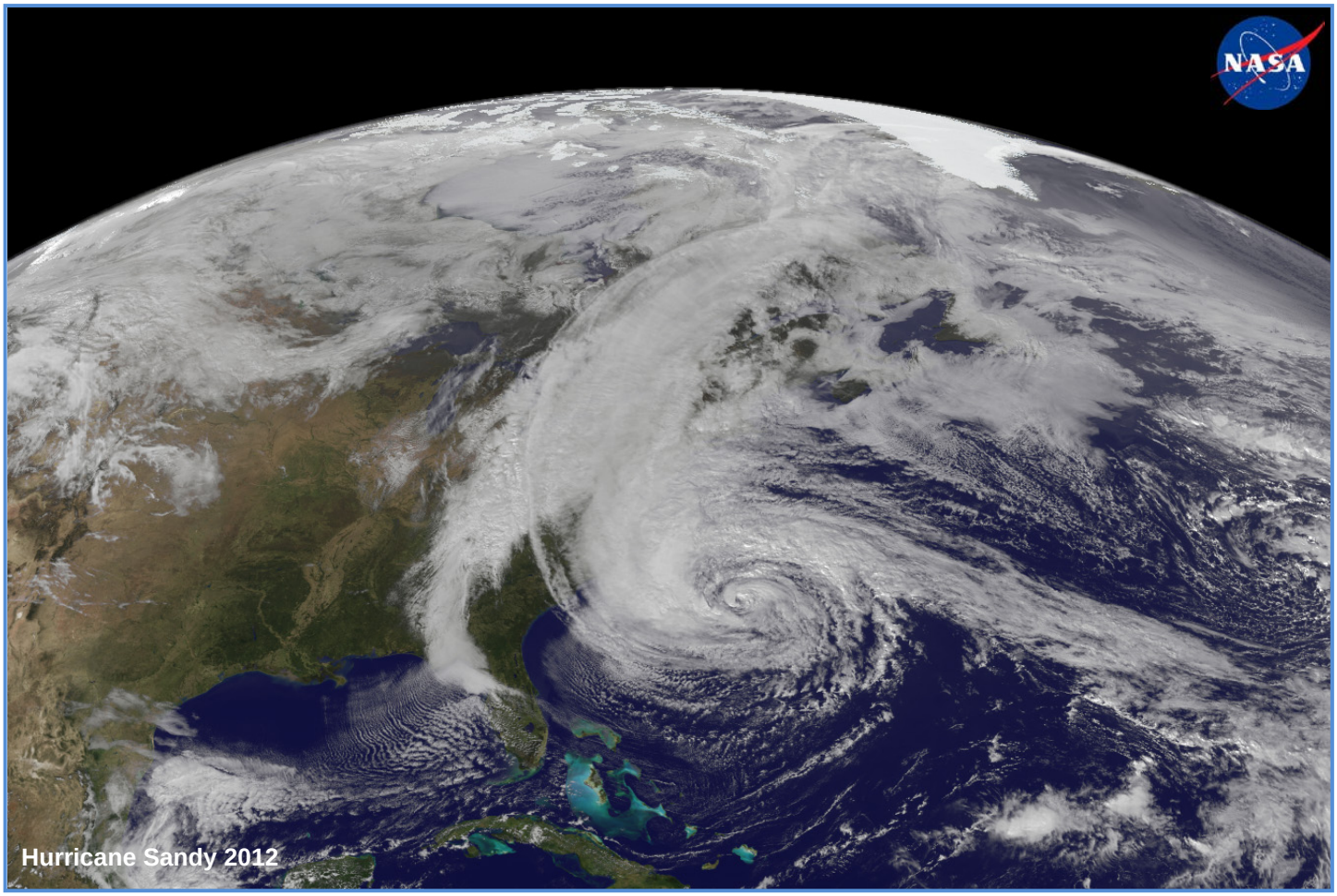
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2011 Standards

Florida Public Hurricane Loss Model
Florida International University

On-Site Review
January 21-23, 2013

Additional Verification Review
April 15, 2013

On January 21-23, 2013, the Professional Team conducted an audit on-site at Florida International University (FIU) in Miami, Florida of the Florida Public Hurricane Loss Model. The following individuals participated in the review:

FIU

Bachir Annane, Senior Research Associate III, CIMAS/HRD
Shu-Ching Chen, Ph.D., 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., Miami, Florida
Fausto Fleites, Consultant and Ph.D. Candidate, Florida International University
Raul Garcia, Student Programmer, Florida International University
Teresa Grullon, Administrative Assistant/Technical Editor
Sneh Gulati, Ph.D., Professor, Department of Math & Statistics, Florida International University
Kurt Gurley, Ph.D., Associate Professor, Department of Civil and Coastal Engineering, College of Engineering, University of Florida
Hsin-Yu Ha, Ph.D. Candidate, Florida International University
Shahid Hamid, Ph.D., CFA, Professor, Director of MSF Program, Florida International University, Director of the Laboratory for Insurance, Financial and Economic Research, International Hurricane Research Center at Florida International University, PI and Project Director, Florida Public Hurricane Loss Model
Golam Kibria, Ph.D., Associate Professor of Statistics, Florida International University
Dianting Liu, Ph.D. Candidate, University of Miami
Diana Machado, Student Programmer, Florida International University
Jean-Paul Pinelli, Ph.D., Professor, Department of Civil Engineering, Florida Institute of Technology
Mark Powell, Ph.D., Senior Atmospheric Scientist, NOAA Hurricane Research Division, AOML
Johann Weekes, Ph.D. Candidate, Civil Engineering, University of Florida
Yimin Yang, Ph.D. Candidate, Florida International University

Professional Team

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

The review began with introductions and an overview of the audit process by the Professional Team.

FIU then gave a presentation on the changes in the model from the previous submission and their impact on the loss costs.

1. Update of probability distribution functions incorporating HURDAT revisions
2. Change in Rmax to include 7 additional observations from the 2007-2010 seasons
3. Update of ZIP Code centroids
4. Modification of hurricane PBL height
5. Update of wind-borne debris region boundaries

6. New components for metal roof and metal shutters added to the personal residential model
7. Update of personal residential strong model to include an upgraded (modified) strong option reflecting Florida Building Code requirements for sheathing nailing schedule, roof to wall connection products, and shingle products for High Velocity Hurricane Zone (Miami-Dade and Broward Counties)
8. Update of personal residential strong model to increase window pressure capacities
9. Modification of roof life cycle to be a constant cycle of 30 years for all roofs
10. New components for soffit, metal shutters and metal roof added to the low rise commercial residential model
11. Modification of window protection in the presence of metal shutters, debris impact model, rain adjustment factors, windspeed variation with height of rain model, costing scheme, wall sheathing capacities, window capacities for strong model, pressure coefficients for hip roof models, relationship between ASCE versus model pressure coefficients, roof to wall connection capacities, roof to wall failure connection algorithm, and masonry wall capacity in the low rise commercial residential model
12. New features for debris impact zones, option with no sliders, differentiation between damaged and breached openings added to the mid/high rise commercial residential model
13. Modification of opening pressure capacities, external damage costing scheme, interior damage cost coefficient, and number of windows in open layout in the mid/high rise commercial residential model.

The modeler disclosed the following errors or omissions in the submission during the model changes discussion.

1. Update of probability distribution functions for HURDAT revisions and changes in Rmax not separated under G-1, Disclosure 5.A, B, and C.
2. Roof life cycle change not included in model changes under G-1, Disclosure 5.A.
3. Forms V-1, V-2, and V-3 incorrect in submission.

In 2011, the Professional Team performed two reviews of the Florida Public Model. The first review was on-site and conducted March 14-17, 2011. The second, additional verification, review was held on June 6 and 7, 2011. During these reviews, the Professional Team emphasized existing poor correspondence and connections between, and among, different model teams. These teams include experts in meteorology, actuarial science, structural engineering, statistics, and computer science. The modeler produced measures designed to mitigate problems occurring as a result of the problems in correspondence and communication. These measures were discussed on Page 4 (Preamble) and Page 61 (Standard C-1) of the Professional Team's 2011 report.

During the current audit, it became clear that many of the same substantial issues raised during the 2011 audit remained. In particular, inter-group communications remain problematic. The Professional Team emphasized the importance of improving these issues. Dr. Shahid Hamid (signatory on Form G-1) recognized that problems continue to exist. Dr. Hamid introduced a new written policy designed to further mitigate errors that appear to result from lack of coordination and communication. The Professional Team remains concerned about the recent history (2011-2013) of the coordination and communication problems. If the recent policy is successfully implemented, these problems should be mitigated.

In auditing the model, the Professional Team identified discrepancies in version dates between the model in the Source Versioning System and the submission timeline. The Source Versioning System has not been adopted by all modeler groups. Although evidence was provided to indicate

that the model being reviewed and the model submission were concurrent, the system in place is not adequate.

A fully operational Source Versioning System needs to be implemented and then demonstrated with a re-run of the output ranges to assure that the current version of the model concurs with what was submitted. If these output ranges agree with those in the November 2012 submission, no further forms need to be completed.

The Professional Team was unable to verify standards G-1 (Scope of the Computer Model and Its Implementation) and C-6 (Model Maintenance and Revision). Consequently, G-4 (Independence of Model Components) and A-6 (Loss Output) also could not be verified as they require the verification of the aforementioned two standards. At the exit briefing, modeler options as given in the Report of Activities were presented to the modeler.

The Professional Team reviewed on-site many corrections including, but not limited to, the following corrections to be included in the revised submission that will be provided to the Commission no later than 10 days prior to the meetings for reviewing models for acceptability.

- Standard G-1, Disclosure 2
- Standard G-1, Disclosure 4
- Standard G-1, Disclosure 5
- Standard M-2, Disclosure 3
- Standard V-1, Disclosure 7
- Standard V-2, Disclosure 1
- Standard V-2, Disclosure 5
- Standard A-5, Disclosure 1
- Standard S-1, Disclosure 1
- Standard S-2, Disclosure 4
- Standard S-3, Disclosure 4
- Form V-1
- Form V-2
- Form V-3
- Form S-3
- Form S-4
- Table 1a
- Table 1b
- Table 6
- Table 9
- Table 10
- Table 21
- Table 24
- Table 25
- Figure 1
- Figure 12
- Figure 16
- Figure 18
- Figure 56
- Figure 67

Additional Verification Review – April 15, 2013

FIU submitted revisions to the original November, 2012 model submission under the 2011 Standards on March 1, 2013. Supplementary revisions were received on April 9, 2013. The Professional Team completed the additional verification review on April 15, 2013 in Miami.

The following individuals participated in the additional verification review:

FIU
Bachir Annane, Senior Research Associate III, CIMAS/HRD
Shu-Ching Chen, Ph.D., 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., Miami, Florida
Raul Garcia, Student Programmer, Florida International University
Teresa Grullon, Administrative Assistant/Technical Editor
Sneh Gulati, Ph.D., Professor, Department of Math & Statistics, Florida International University
Hsin-Yu Ha, Ph.D. Candidate, Florida International University
Shahid Hamid, Ph.D., CFA, Professor, Director of MSF Program, Florida International University, Director of the Laboratory for Insurance, Financial and Economic Research, International Hurricane Research Center at Florida International University, PI and Project Director, Florida Public Hurricane Loss Model
Dianting Liu, Ph.D. Candidate, University of Miami
Diana Machado, Student Programmer, Florida International University
Jean-Paul Pinelli, Ph.D., Professor, Department of Civil Engineering, Florida Institute of Technology
Mark Powell, Ph.D., Senior Atmospheric Scientist, NOAA Hurricane Research Division, AOML

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

The additional verification review began with a discussion of the outstanding issues from the initial on-site review in January. FIU confirmed no additional changes were discovered or made since the March 1, 2013 revised submission other than the corrections provided on April 9, 2013 for the percentage changes in statewide loss costs due to updated ZIP Code centroids, updated Rmax and HURDAT, and modification of the hurricane planetary boundary layer height. The overall change in loss costs resulting from their meteorological component changes was not impacted.

FIU began with a presentation on a version control system used by all model components to track all modifications to the code, model input data, and documentation. FIU stated project meetings were held to review SVN functionality, to discuss the repository structure, and to set up SVN clients. Individual meetings were also held to reinforce SVN knowledge. FIU demonstrated that SVN is now consistently used by all model components.

FIU explained the percentage changes in output range loss costs were revised because the percentage changes in the November 2012 submission were not reproducible nor were the values provided in the March 2013 resubmission. The decision was made to start over and recalculate the differences to correctly isolate each meteorological component change and the combined Rmax and HURDAT change. FIU stated process changes including archival of pertinent scripts have been implemented and should eliminate this type of error from occurring in the future.

The Professional Team reviewed all materials in the re-submission that were impacted by the corrections noted previously.

All standards are now verified by the Professional Team.

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the December 17, 2012 meeting. The deficiencies were corrected by the established time frame, and the corrections have been verified.

1. Model Submission Checklist (page 5)
   Response is incomplete. Item 8 is marked "Yes," but the page numbers stop at 345 in the PDF file of 453 pages, and the sequential page numbering stops at 350 in the hard copy version with the remainder of the over 100 pages with no sequential page number.

2. Standard G-1.A (page 16)
   Response is incomplete as the response given is not separated into a response to Part A and a response to Part B.

3. Standard G-1, Disclosure 5.A (page 99)
   Response is non-responsive as centroids are not to be based on the 2010 Census. This statement conflicts with the response to Standard G-3 (page 118).

4. Standard G-1, Disclosure 5.C (pages 104-109)
   a. Response is unclear as maps provided in Figures 20-22 are not delineated by county.
   b. Response is incomplete as the maximum and minimum values and locations were not provided in Figures 20-25 as required by II.A.5.e.3 in the *Report of Activities (page 46).*

5. Standard G-2 (pages 110-117)
   Disclosures are numbered incorrectly.

6. Standard G-2, Disclosure 14 (page 117)
   Response is incomplete as the link to Form G-6 in the PDF file is non-functional.

7. Form M-2 (pages 158-161)
   Response is incomplete as the maximum and minimum values and locations were not provided in Figures 38-41 as required in II.A.5.e.3 in the *Report of Activities (page 46).*

8. Standard V-1, Disclosure 17 (page 222)
   Response is incomplete as the link to Form V-1 in the PDF file is non-functional.

9. Standard A-6, Disclosure 6 (page 265)
   Response is incomplete as a link to Form A-6 was not provided.

10. Form A-1 (pages 269-271)
    Response is incomplete as maximum and minimum values and locations were not provided in Figures 68-70 as required by II.A.5.e.3 in the *Report of Activities (page 46).*

11. Form A-5 (pages 281-288)
    a. Response is unclear as maps provided in Figures 76-83 are not delineated by county.
    b. Response is incomplete as the maximum and minimum values and locations were not provided in Figures 76-83 as required by II.A.5.e.3 in the *Report of Activities (page 46).*

Report on Issues

At the conclusion of the Additional Verification Review, the Professional Team subset discussed the following issues identified by the Commission at the December 17, 2012 meeting. The modeler will give a detailed presentation to the Commission on these issues during the meeting to review the model for acceptability.

1. Development of loss costs in the model and changes in the loss costs from the last change in the model, specifically how the model treats coastal versus inland loss costs. Be prepared to fully explain the process for incorporating changes in the model including the analyses of the underlying data. More detail to be provided in the presentation and discussion of Form A-5.

2. Describe if the model makes assumptions for adjustor errors or contract ambiguity.

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

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

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

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

The on-site schedule is tentatively planned to proceed in the following sequence: (1) presentation by the modeler of new or extensively updated material related to the model; (2) section by section review commencing within each section with pre-visit letter responses; (3) responses to new or significantly changed standards in the 2011 Report of Activities, and (4) responses to the audit items for each standard in the Report of Activities.

Be prepared to have available for the Professional Team's consideration, all insurance company claims data received since 2004, including all data related to the 2004 and 2005

hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

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

When the Professional Team arrives on-site, provide five (5) printed copies of all figures with scales for the *X* and *Y* axes labeled that are not so labeled in the submission. Label the figures with the same figure number as given in the submission. Also, provide the electronic file used to complete Form V-3 on a removable drive medium. Additionally, provide the electronic file(s) used to complete Form A-7.

Be prepared to provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2009. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

If any changes have been made in any part of the model or the modeling process from the descriptions provided in the original 2011 submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and all revised Forms where any output of the form changed.

As part of the on-site review, the Professional Team is charged with obtaining information regarding the two issues noted in the deficiency letter that will be later considered during the Commission meeting to review the model for acceptability.

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

The pre-visit comments are grouped by standards sections.

GENERAL STANDARDS – Mark Johnson, Leader

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

*(*Significant Revision)*

A. The computer model shall project loss costs and probable maximum loss levels for residential property insured damage from hurricane events.

B. The modeling organization shall maintain a documented process to assure continual agreement and correct correspondence of databases, data files, and computer source code to slides, technical papers, and/or modeling organization documents.

Audit

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

2. The process defined in Standard G-1.B will be: (1) reviewed for its inclusion of all stages of the modeling process, and (2) traced using the Computer Standards for one or more items listed in the response to Disclosure 5.

3. All software (1) located within the model, (2) used to compile data used by the model, (3) used to validate the model, (4) used to project model loss costs and probable maximum loss levels, and (5) used to create forms required by the *Report of Activities*:
    a. Shall fall within the scope of the Computer Standards;
    b. Shall be located in centralized, model-level file areas; and
    c. Shall be reviewable interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each standard).

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

5. Provide the following information related to changes in the model from the initial submission this year to each subsequent revision.
    A. Model changes:
        1. A summary description of changes that affect, or believe to affect, the personal or commercial residential loss costs or probable maximum loss levels,
        2. A list of all other changes, and
        3. The rationale for each change.
    B. Percentage difference in average annual zero deductible statewide loss costs for:
        1. All changes combined, and
        2. Each individual model component change.
    C. For any modifications to Form A-4 since the initial submission, additional versions of Form A-5:

1. With the initial submission as the baseline for computing the percentage changes, and
2. With any intermediate revisions as the baseline for computing the percentage changes.

D. Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide loss costs for each model component change:

1. Between the previously accepted submission and the revised submission,
2. Between the initial submission and the revised submission, and
3. Between any intermediate revisions and the revised submission.

Pre-Visit Letter

1. G-1.B, page 17: Provide documented checklist-based, or other, verification of the followed process documented in Figure 1.

2. G-1, Disclosure 2, page 21: Explain the simulated track with genesis over land in eastern Cuba, traverses most of the country and then exits Cuba and heads north.

3. G-1, Disclosure 2, page 23: Provide to SBA staff with the response to the Deficiencies an Excel file with the radius of maximum winds and corresponding central pressures used in the gamma distribution fit for Rmax.

4. G-1, Disclosure 2, page 25: A new surface friction model is mentioned, but is not mentioned on page 98 with the Meteorological Component changes.

5. G-1, Disclosure 2, page 34: Provide the functional form of the Weibull distribution used here, as the “tail length parameter” term is non-standard.

6. G-1, Disclosure 2, page 54: Clarify whether an upper bound is still imposed on the terminal velocity and provide its value (if relevant).

7. G-1, Disclosure 2, page 56: Make explicit what the reference FPHLM means.

8. G-1, Disclosure 5.A, pages 98-102: Provide in detail the changes to the Vulnerability Component. Describe why the change, how it was implemented, and what are the results and improvements. Provide test plans, tests implementation, and QA of all related software which were generated or modified due to these changes.

9. G-1, Disclosure 5.A.3, page 99: The last bullet under meteorological Component, “the definition…” shall be moved as the first bullet under Vulnerability Component to be consistent with the list given on page 98.

10. G-1, Disclosure 5.B.2, page 102: Discuss and compare the impact from individual changes to impact due to all changes combined. Specifically, it seems all impacts are in the direction of decrease. Explain why decreases of 22% and 47% in the vulnerability component do not compare with an overall decrease of 8.3%.

11. G-1, Disclosure 5.C, page 106: Explain the east-west asymmetry in the response to the hurricane PBL height change.

12. G-1, Disclosure 5.C., page 107: Explain the hanging 2. and 3. at the top of the page.

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

Professional Team Comments:

During the final afternoon of the audit, it was revealed that Disclosure 5B was in error. The numbers for vulnerability reported in the November 2012 submission could not be reproduced, and the numbers reported for the meteorology changes were not complete. Some tentative replacement values were proposed for the disclosure, but the corrected disclosure could not be fully verified and reviewed.

On the first day of the audit, the modeler presented a change in the model that was not previously provided in the November 2012 submission. The update to the model involved a change in the roof life cycle from the previous default of 20 years to the revised 30 years.

In response to this model change, the Professional Team reviewed the documented process required by Standard G-1.B and found it to be inadequate. The documented process included preliminary text and a flowchart illustrated in Figure 1. The flowchart in its original form did not capture the process used by the modeler personnel to verify a relationship between model requirements and the implementation of the model.

The modeler produced two types of changes to Figure 1 and presented the revised flowchart to the Professional Team. The revised flowchart included a) clarification on which modeler personnel performed which specific functions, and b) clarification on the nature of communication among the Computer Science group, and other modeler groups (meteorology, statistics, engineering, actuarial science).

Discussed the effectiveness of the approach implemented after the last Professional Team on-site review to improve the process for ensuring consistency between flowcharts and implementation in the computer source code. The Professional Team emphasized the need to implement and adhere to a policy that mandates that the process specified in the Figure 1 flowchart actually be followed.

The modeler produced a new policy entitled “Policy to require changes in codes will follow the procedure shown in Figure 1 of FPHLM V5.0 document.” The purpose of this new policy is to ensure that the modeler implements the process identified in Figure 1. The policy outlines the approach used by the modeler to ensure correspondence among documents, slides, and particularly flowcharts, and the computer code implementation.

Discussed with the modeler the adherence of the modeler to the new policy, which will result in a more cohesive set of connections among individual group personnel. The Professional Team expressed concern with the possibility of other instances of ad hoc updates with numerous changes in the vulnerability component alone. Discussed the improvements and assurances for following the documented process and policy in the future.

Reviewed in detail the changes to the meteorological and vulnerability model components.

Discussed the examples of simulated hurricane tracks in Figure 3 representing the initiation of the storm tracks in the model rather than the genesis of the tropical cyclone itself.

Reviewed the Rmax and corresponding central pressures used in the gamma distribution fit for Rmax.

Language revised on page 25 to delete obsolete wording related to the marine surface winds from the slab model adjustment to land surface winds.

Verified the upper bound of 9.2 m/s imposed on the terminal velocity remained unchanged from Version 4.1. Discussed the mass flux contribution to raindrops that are large enough to achieve the terminal velocity being negligible so that the upper bound has no practical effect on the calculation of the driving rain factor.

Discussed information provided in Table 9. A revised table was provided to clarify the references and the portion of the model where it applies.

Discussed the east-west asymmetry in the hurricane primary boundary layer height change depending nonlinearly on windspeed, roughness, and distance to coast. The vulnerability depends nonlinearly on windspeed and exposure which has significant regional variation.

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

Reviewed the revised percentage changes in loss cost values for the vulnerability and meteorological component changes.

Reviewed process and scripts for calculating the percentage changes in loss costs. Discussed the reason for recalculating the percentage changes for the meteorological component changes to appropriately reflect each individual change. FIU stated an unidentifiable error(s) must have occurred when producing the initial percentage changes for the meteorological component. Verified the total overall statewide percentage changes did not change, only the percentage changes for each individual meteorological component. Discussed the fully automated scripts and formalized process for generating and documenting the percentage changes to eliminate this problem in the future.

Reviewed revisions to the new policy entitled “Policy to require changes in codes will follow the procedure shown in Figure 1 of FPHLM V5.0 document” created originally during the initial on-site review to include the procedures for using a Version Control System.

G-2 Qualifications of Modeling Organization Personnel and Consultants

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

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

Audit

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

2. Forms G-1, G-2, G-3, G-4, G-5, G-6, and all independent peer reviews of the model under consideration will be reviewed. Signatories on the individual forms will be required to provide a description of their review process.

3. Discuss any incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

13. G-2, Disclosure 2.B, page 114: Resumes for the new employees listed should be available.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Roberto Aleman, Florida International University Masters student, Computer Science; B.S. Computer Science, Florida International University
- Laura Alonso, Florida International University student, Information Technology
- Steven Bell, Florida Institute of Technology Masters student, Civil Engineering; B.S. Civil Engineering, Florida Institute of Technology, Melbourne, Florida
- Raul Garcia, Florida International University student, Major: Computer Science

- Teresa Grullon, Administrative Assistant, Florida International University, International Hurricane Research Center; Certificate of Supervisory Management, Institute of Financial Education
- Dianting Liu, Ph.D. candidate, Department of Electrical and Computer Engineering, University of Miami, Florida; Ph.D. Mechanical Engineering, Dalian University of Technology, China; B.S. Mechanical Engineering, Dalian University of Technology, China
- Diana Machado, Florida International University student, Major: Computer Science; B.A. Social Communication, University of Havana, Havana, Cuba
- Alex Sarracino, Florida International University student, Major: Computer Science

G-3 Risk Location

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

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

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

Audit

1. Provide geographic displays for all ZIP Codes.

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

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

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

Verified: YES

Professional Team Comments:

Reviewed impact of changes due to update of ZIP Code centroids. Loss costs decreased with the largest variations occurring for coastal areas with low population.

Reviewed geographic displays of ZIP Codes and comparisons of new centroid locations to previous locations for the entire state.

G-4 Independence of Model Components

The meteorological, vulnerability, and actuarial components of the model shall each be theoretically sound without compensation for potential bias from the other two components.

Audit

1. Demonstrate that the model components adequately portray hurricane phenomena and effects (damage, loss costs, and probable maximum loss levels). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model would not meet this standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards G-1 and C-6.

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

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

Verified after resolution of outstanding issues with Standards G-1 and C-6.

G-5 Editorial Compliance

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

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 December 31, 2011*.

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

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

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

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

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

7. Form G-7 will be reviewed.

Verified: YES

Professional Team Comments:

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 have been identified. The modeler is responsible for eliminating such errors.

Discussed with Teresa Grullon her process for editorial review.

A comprehensive review by the Technical Editor for typographical errors and grammar errors did not commence until after the submission was made, owing to last minute preparations by the various groups. There were a large number of change pages provided on arrival and during the audit.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of August 15, 2011 (or later). Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

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

Audit

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

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

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

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

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

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

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

Verified: YES

Professional Team Comments:

Verified implementation of the updates to the Base Hurricane Storm Set used HURDAT as of May 2012. This historical storm set includes 1900 through 2011 hurricane seasons and the reanalysis through 1935.

Reviewed the update of probability distribution functions incorporating the revision of storms in the 1926-1935 HURDAT reanalysis. Loss costs increased approximately 4% with large regional variations. Reviewed revisions to following storms affecting Palm Beach and Martin Counties:

- 1926 storm – significant increase in intensity
- 1928 storm – significant change in path (landfall from Martin to Palm Beach County)
- 1933 storm – significant change in path (landfall now in Martin County)
- 1933 storm – increase in intensity at landfall in Martin/Palm Beach area
- 1935 storm – increase in intensity of by-passing storm

Discussed that no short- or long-term variations are imposed.

Forms M-1 and S-1 were reviewed.

M-2 Hurricane Parameters and Characteristics

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

Audit

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

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

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

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

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

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

Pre-Visit Letter

14. M-2, page 130: Clarify the HURDAT version used for the storm initial position and motion.

15. M-2, Disclosure 1, page 130: Explain the decrease in the number of Rmax observations (from 108 to 100) with the addition of five more years (2006-2010) to the landfall Rmax database. Provide to SBA staff with the response to the Deficiencies an Excel file with the previous and current Rmax datasets.

16. M-2, Disclosure 5, page 134: Discuss the rationale for the change of the hurricane PBL height to 450 m and the structure of its impacts on the simulated hurricane windfield.

17. M-2, Disclosure 5, page 134: Given the change in hurricane PBL depth, justify the continued use of 77.5% for adjustment of mean boundary layer winds to surface winds.

Verified: YES

Professional Team Comments:

Verified the version of HURDAT used for the initial storm location, motion and over-water pressure tendency is dated as of May 14, 2012.

Reviewed the change in value for the planetary boundary layer (PBL) used in the terrain conversion and coastal transition equations. PBL height for terrain conversion was decreased from 500m to 450m to be consistent with the PBL height used in the wind model. Loss costs decreased by approximately 3% with virtually no change within a few miles of the coast and the largest change for windspeeds around 40 mph. There was no impact on open terrain wind calculations as the wind model did not change. For actual terrain surface winds, there is a slight decrease in winds for inland locations (varying with roughness factor) and almost no change in coastal areas.

Reviewed graphical comparisons of percent change in windspeeds for inland and coastal locations and with three different roughness factors.

Verified no change in the adjustment factor used to convert the slab mean to 1-minute surface winds in the wind model.

M-3 Hurricane Probabilities

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

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

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

Saffir-Simpson Hurricane Scale:

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

Audit

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

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

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

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

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

Verified: YES

Professional Team Comments:

Discussed that quality of fits extend outside of Florida.

Verified no change in the methodology used to generate stochastic storm tracks.

Reviewed revised Form S-3 to include all probability distributions and data sources.

Reviewed change in Rmax to include seven additional observations for the 2007-2010 hurricane seasons resulting in small changes in the gamma fit. Loss costs decreased approximately 1.3% with some sampling variation included. Figure 20 in the original submission reflects percent change in loss costs due only to the Rmax update.

Reviewed the Rmax datasets provided with the response to the Deficiencies.

Discussed use of an approximation for the MLE for gamma fit of Rmax based on the digamma function. Reviewed EasyFit goodness of fit summary test results by the Meteorology team.

Discussed Rmax values for 1985-1987 and 2004-2005 subsets of storms. Modeler provided description of sources of Rmax values for these cases. Multiple Elena (1985) Rmax values include near-landfall locations. Apparent differences in accuracy arise from differing units in initial Rmax estimate (sm, nm, km) based on method or data source used.

M-4 Hurricane Windfield Structure

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

B. The translation of land use and land cover or other source information into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.

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

Audit

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

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

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

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

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

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

7. The effects of vertical variation of winds as used in the model where applicable will be reviewed.

8. Form M-2 will be reviewed.

Pre-Visit Letter

18. M-4.B, page 139: Describe the methods used to update the Land Use/Land Cover database used from the 2001 distributions inherent in the LCD 2001 database.

19. M-4, Disclosure 7, page 141: Discuss the currency of the Land Use/Land Cover database used.

20. Form M-2, pages 158-161: Discuss the variations in location between maxima for actual and open terrain for each time period plotted in Form M-2.

21. Form M-2, pages 158-161: Justify the increase or maintenance of the maximum windspeed for actual terrain compared to open terrain, given that windspeeds for actual terrain are almost uniformly weaker across the state than for open terrain.

Verified: YES

Professional Team Comments:

Discussed the 2001 date of the National Land Cover Database (NLCD) used in the model. Discussed the modeler progress in processing the 2012 USGS release. Discussed Public Model opinion that the Florida Water Management District data is better at classifying residential areas and the degradation in accuracy might outweigh the benefits of more recent data. Discussed that modeler plans to review the new NLCD in more detail.

Discussed the variations in location between maxima for actual and open terrain in Form M-2. Variations of maxima for open and actual terrain depend on the degree of marine exposure and effective roughness which can have a significant impact on the wind. The actual terrain wind calculations include the effect of transition from upstream marine roughness to local roughness allowing actual terrain winds (actual roughness less than open terrain roughness) to exceed open terrain winds near the coast.

M-5 Landfall and Over-Land Weakening Methodologies

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

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

Audit

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

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

3. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed. Provide color-coded snapshot maps of roughness length and spatial distribution of windspeeds over-land and over-water for Hurricane Jeanne (2004), Hurricane Dennis (2005), and Hurricane Andrew (1992) at the closest time after landfall.

Verified: YES

Professional Team Comments:

Verified no changes in the model treatment of over-land decay from the previous submission.

Reviewed method for transitioning winds from over-water to over-land used in the model. Method is based on Vickery et al. (2009) representation of internal boundary layer development at coast. Verified no change in method. Use of 450m for boundary layer height in terrain conversion results in very small differences near coast.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

1. Form M-3 and the modeling organization's sensitivity analyses provide the information used in auditing this standard.

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

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

Verified: YES

Professional Team Comments:

Verified no change in the treatment of hurricane asymmetry from the previous submission.

Discussed the bounds on Rmax evident in Figure 42 in Form M-3. Modeler confirmed that these bounds were imposed on the distribution. The submission was updated to reflect this.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

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

B. The method of derivation of the vulnerability functions and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.

C. Residential building stock classification shall be representative of Florida construction for personal and commercial residential properties.

D. Building height/number of stories, primary construction material, year of construction, location, and other construction characteristics, as applicable, shall be used in the derivation and application of vulnerability functions.

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

F. The minimum windspeed that generates damage shall be consistent with fundamental engineering principles.

G. Vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Vulnerability functions shall not include explicit damage to the structure due to flood, storm surge, or wave action.

Audit

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

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

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

4. Justify the construction types and characteristics used.

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

6. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement. If age of building is used as a surrogate for building code and code enforcement, provide complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s).

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

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

9. Describe whether and/or how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify vulnerability functions. Examples include the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.

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

11. Form V-1 will be reviewed.

Pre-Visit Letter

22. V-1, Disclosures 8-14, pages 214-221: Disclosures 8 through 14 are new disclosures for V-1. Prepare to discuss in depth.

23. V-1, Disclosure 13, page 218: Explain highest point at around $275,000,000 actual structure losses in Figure 52.

24. V-1, Disclosure 13, page 219: Explain 2 points above $40,000,000 of modeled losses versus approximately $10,000,000 in contents losses.

26. Form V-1, pages 233-234: Describe the process and provide the documentation for all steps to complete Form V-1. Discuss the reasons why Part A damage ratios for high windspeeds have decreased significantly relative to the previous submission. Provide a comparison of the previous submission vulnerability functions to the current

submission. Explain the small decrease for wood frame, masonry, and mobile home in Part B where concrete damage ratios have increased.

Verified: YES

Professional Team Comments:

Reviewed in detail the updates to the vulnerability component of the model.

Reviewed four major changes in vulnerability components, each having a number of changes.

While on-site, two additional changes were identified, reviewed, and discussed in detail. Pages of submission were revised to summarize the changes and the rationale behind them.

The above two additional changes were made in roof life time and consolidation of four footprints into two footprints for timber and masonry construction. These two changes impacted the vulnerability functions used for reference structures for the Forms V-1, V-2, and V-3.

Revised Forms V-1, V-2, and V-3 were produced by the modeler and were reviewed and discussed in detail.

Discussed the update to a 30 year roof life cycle based on engineering judgment and site inspections.

Reviewed Table 1604.5, Risk Category of Buildings and Other Structures from the 2010 Florida Building Code effective March 2012 used as the basis for updating the wind-borne debris region boundaries.

Reviewed the underlying data driving the loss cost changes for the new vulnerability functions for the mid-high rise commercial residential model. Reviewed the results for Pasco and Hernando Counties.

Reviewed the increase in vulnerability matrices from 1032 in the previous submission to 4356 in the current submission.

Reviewed the development of vulnerability functions for appurtenant structures, contents damage, and time element.

Discussed additional living expenses are modeled as a function of interior damage.

Discussed there is no relationship between building structure and appurtenant structure vulnerability functions as they were developed independently.

Discussed sample vulnerability function relationships against claims data.

Reviewed the assumptions used in the development of “other” and “unknown” vulnerability functions and their differences. Structures are classified as “unknown” when information is missing and are assigned a vulnerability based on the statistics of the building population for that location. Structures classified as “other” are assigned a vulnerability based on an average of timber and masonry matrices.

Reviewed Table 5, Assignment of Vulnerability Matrix Depending on Data Availability in Insurance Portfolios. Reviewed SQL processing for Case 2 in the table.

Discussed assumptions used to develop commercial residential construction types. Low-rise condominium and apartment buildings are 1-3 stories, and 4 or more stories are classified as mid/high-rise. Low-rise buildings are treated analogously to single family homes and are modeled as a whole. Mid/high-rise buildings are treated as a collection of apartment units and the roof is assumed to be a flat concrete slab.

Discussed no change in the model to account for company claims payment practices.

Reviewed vulnerability functions relationships by type of coverage with claims data provided in Figures 52 through 55.

Reviewed the process for completing Form V-1. A revised Form V-1 was provided and reviewed during the audit. The modeler changed the insured value of the reference concrete structure from $100,000 to $15,000,000 and converted the windspeeds from 1-minute sustained winds to 3-second gusts needed for damage calculations.

Reviewed comparison of vulnerability functions for unknown strong versus unweighted 2-story concrete block strong hip roof aluminum shutters for masonry and frame condo units.

Reviewed plot of contents damage relationship to building damage.

V-2 Derivation of Contents and Time Element Vulnerability Functions*

*(*Significant Revision)*

A. The relationship between the modeled structure and contents vulnerability functions and historical structure and contents losses shall be reasonable.

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

C. The relationship between the modeled structure and time element vulnerability functions and historical structure and time element losses shall be reasonable.

D. Time element vulnerability functions used by the model shall include time element coverage claims associated with wind, flood, and storm surge damage to the infrastructure caused by a hurricane.

Audit

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

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

3. Documentation and justification of the following will be reviewed:
    a. The method of derivation and data on which the time element vulnerability functions are based;
    b. Validation data specifically applicable to time element coverages;
    c. Assumptions regarding the coding of time element losses by insurers;
    d. The effects of demand surge on time element for the 2004 and 2005 hurricane seasons;
    e. Assumptions regarding the variability of time element losses by size of property;
    f. Statewide application of time element coverage assumptions;
    g. Assumptions regarding time element coverage for mobile homes, tenants, and condo unit owners exposure;
    h. The methods used to incorporate the estimated time required to repair or replace the property;
    i. The methodology and available validation for determining the extent of infrastructure damage and its effect on time element costs.

4. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for time element.

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

Pre-Visit Letter

25. V-2, pages 223-226: Discuss in depth and provide supporting documentation.

Verified: YES

Professional Team Comments:

Discussed the relationship among modeled structure and contents loss costs, and among modeled structure and time element loss costs.

Discussed in detail the relationship between content damage ratios and building damage ratios for model losses versus the same for actual losses for Hurricane Andrew (1992).

Discussed commercial residential contents damage being a function of water penetration.

The Professional Team expressed concern with modeling commercial residential mid/high-rise contents damage and time element losses due to water penetration only from damage to entry doors, sliding doors, and windows. Modeler responded concerns were noted and they are thinking of ways to handle this issue in a future version of the model. Damage to roof and cladding and subsequent water damage shall be reviewed in the future.

Reviewed the flowcharts and documentation for interior damage and associated content damage as it relates to interior damage.

Reviewed functional relation of content to interior damage.

Reviewed and discussed the three functional relations of time element to interior damage.

V-3 Mitigation Measures

A. Modeling of mitigation measures to improve a structure's wind resistance and the corresponding effects on vulnerability shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include fixtures or construction techniques that enhance the performance of the structure and its contents and shall consider:

- ***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 that enhance the performance of the structure and its contents shall be justified as to the impact on reducing damage whether done individually or in combination.

Audit

1. Form V-2 and Form V-3 (Trade Secret item) provide the information used in auditing this standard.

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

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

Pre-Visit Letter

27. Form V-2, page 239: In lieu of changes observed in Form V-1, explain why Form V-2 has not changed.

Verified: YES

Professional Team Comments:

Reviewed multiple revisions to Forms V-2 and V-3.

Reviewed the consolidation of the footprint options used to generate damage vulnerability matrices. Discussed justification for the change and discussed that the vulnerability matrices are still regionally different due to differences in weighting of structure age and cost differences by region. The implementation of this reduction did not require any changes to the model; however, Forms V-2 and V-3 were influenced by the changes.

Discussed Form V-2. Reviewed vulnerability curves for the reference frame and masonry structures in mitigation set 3.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeling Input Data

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed procedure for processing incorrect insurer data. The modeler corrects and sets the input values and notifies the insurer of the changes. Insurers are not allowed to select optional features in the model.

A-2 Event Definition*

*(*Significant Revision)*

A. Modeled loss costs and probable maximum loss levels shall reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.

B. Time element loss costs shall reflect losses due to infrastructure damage caused by a hurricane.

Audit

1. The model will be reviewed to determine that the definition of an event in the model is consistent with this standard.

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

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

Verified: YES

Professional Team Comments:

Verified no change in the definition of an event or the handling of by-passing storms in the model.

A-3 Modeled Loss Cost and Probable Maximum Loss Considerations

A. Loss cost projections and probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

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

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

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

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

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

Audit

1. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, economic inflation, and any criteria other than direct property insurance claim payments.

2. The method of inclusion of secondary uncertainty in the probable maximum loss levels will be examined.

3. Provide the data and methods used to incorporate individual aspects of demand surge on personal and commercial residential coverages, inclusive of the effects from building material costs, labor costs, contents costs, repair time, etc.

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

Verified: YES

Professional Team Comments:

No indication of modeled loss costs including expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin. The model does not make a prospective provision for economic inflation.

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

Verified no change in the previously accepted methodology for demand surge calculations.

A-4 Policy Conditions

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

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

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

Audit

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

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

3. To the extent that historical data are used to validate the model results, the treatment of the effects of deductibles, policy limits, and coinsurance in the data will be reviewed.

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

Verified: YES

Professional Team Comments:

Verified no change in the process for calculating and applying deductibles and policy limits from previously accepted submission.

A-5 Coverages

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

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

Audit

The methods used to produce contents and time element loss costs will be reviewed.

Pre-Visit Letter

29. A-5, Disclosure 1, page 262: Describe the process whereby contents losses are a function of the internal damage to the structure. Describe the engineering judgment described under the "Personal Residential" heading.

30. A-5, Disclosure 1, page 263: Describe the process where contents losses are a function of the internal damage to the structure. Describe the engineering judgment cited under the "Commercial Residential" heading.

Verified: YES

Professional Team Comments:

Reviewed contents damage for commercial residential as a heuristic function of exterior damage and assumed to be proportional to the predicted interior damage and validated against claims data. Reviewed the algorithm for contents damage validation.

Discussed in detail the relationship between content damage ratios and building damage ratios for model losses versus the same for actual losses for Hurricane Andrew (1992).

Reviewed the development of the time element demand surge function. Discussed the relationship between structure damage and time element losses.

A-6 Loss Output*

*(*Significant Revision)*

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

B. 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.

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

D. Loss costs cannot increase as the quality of construction type, materials and workmanship increases, all other factors held constant.

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

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

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

H. The relationship of loss costs for individual coverages, (e.g., structures and appurtenant structures, contents, and time element) shall be consistent with the coverages provided.

I. Output ranges shall be logical for the type of risk being modeled and deviations supported.

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

1. masonry construction versus frame construction,

2. personal residential risk exposure versus mobile home risk exposure,

3. inland counties versus coastal counties, and

4. northern counties versus southern counties.

A-6 Loss Output (Continued)

K. For loss cost and probable maximum loss level estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) coinsurance, (4) contractual provisions, and (5) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be appropriate based on the type of risk being modeled.

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-8.
2. All referenced literature will be reviewed to determine applicability.
3. Graphical representations of loss costs by ZIP Code and county will be reviewed.
4. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.
5. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-6, and A-7 will be used to assess coverage relationships.
6. The total personal and commercial residential insured losses provided in Forms A-2 and A-3 will be reviewed individually for total personal residential and total commercial residential insured losses.
7. Forms A-4 and A-5 will be reviewed, including geographical representations of the data when applicable.
8. Justify all changes in loss costs from the previously accepted submission.
9. Form A-4 will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.
10. Anomalies in the output range data will be reviewed and shall be justified.

Pre-Visit Letter

28. Provide detailed results for Monroe County at the ZIP Code level for all Actuarial forms. Also, explain the results for Low Mobile Homes versus Low Commercial Residential.

31. Form A-5, page 286: Explain results for Gilchrist and Dixie Counties.

32. Form A-5, page 288: Explain results for area around Martin County.

33. Form A-6, Appendix F: Describe the process and provide the documentation for all steps to complete Form A-6. Describe the steps taken to ensure sensibility of the results.

34. Form A-7, Appendix G: Describe the process and provide the documentation for all steps to complete Form A-7. Describe the steps taken to ensure sensibility of the results.

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards G-1 and C-6.

Reviewed in detail a series of loss cost anomalies.

Reviewed the ZIP Code associated with the low mobile home loss costs, a single unit in 33051 in the exposure data.

Reviewed the Calhoun County commercial residential exposure producing lower loss costs than neighboring counties. Discussed that Calhoun County had only a single low-rise 1995 building, where the neighboring counties are a mix of old and new structures.

Reviewed the masonry veneer single frame condo exposure in Union County ZIP Code 32054 treated as frame in the model. Discussed updates to frame and concrete vulnerability functions as used in the model.

Reviewed the Monroe County values in Form A-4. Low mobile home is a single strong unit in ZIP Code 33051, and low commercial residential value is high due to 1985 era low-rise units in every ZIP Code. Reviewed weighted masonry era vulnerability curves comparison for Florida Keys.

Discussed the anomalies in Form A-6 in Broward and Miami-Dade Counties. The model assumes 1998, medium in notional set, and 2007, strong in notional set, are the same strength in the High Velocity Hurricane Zone. The medium case has unknown mitigation attributes where the strong case has known attributes. For condo the weighted vulnerability matrices used for medium case produce a lower loss cost than the unweighted matrix used on the strong case. The weighting is based on the statistics for the location.

Reviewed Form A-5 results for Monroe County at the ZIP Code level. Discussed the process used by the modeler to review all Monroe County ZIP Code level results in the Actuarial forms.

Reviewed the condo frame loss cost changes in Form A-5. 0% change in Gilchrist County due to no condo frame exposure in the county. The 29% change in Dixie County was due to ZIP Code centroid change.

Reviewed commercial residential loss cost increases in Martin County in Form A-5. Loss costs increased in all ZIP Codes due to historical storm track revisions from HURDAT reanalysis with landfall and intensity changes impacting this county (Standard M-1).

Discussed the process for completing Forms A-6 and A-7 and reviewing the results.

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

Verified Form A-4 (Output Ranges) was rerun and that results were in agreement with those submitted in November 2012.

Verified after resolution of outstanding issues with Standards G-1 and C-6.

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 statistical agreement using currently accepted scientific and statistical methods for the academic disciplines appropriate for the various model components or characteristics.

Audit

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

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

Pre-Visit Letter

36. Form S-2, page 318: Explain how a majority of the years have no landfalling hurricanes in Florida yet the median loss is non-zero for the Personal and Commercial Residential Loss FHCF Data Set whereas the median is zero for the Notional Risk Data Set.

37. Form S-3, page 319: Explain the justification in Form S-3 for the Rmax distribution that notes the Rmax is semi-bounded but the implementation (page 133) reveals that Rmax is restricted to [4, 60].

38. Form S-3, page 319: Provide a complete list including distributions given on page 56. Also, the genesis positions have small uniform random error terms added. Ensure that Form S-3 is complete.

Verified: YES

Professional Team Comments:

Discussed the median value of zero in Form S-2.

Discussed how the model accumulates losses for bypassing hurricanes.

Rmax description in Form S-3 was revised to reflect updates.

Discussed the lack of interaction between the Meteorology personnel and the Statistical personnel in reviewing the distribution fitting and the goodness of fit test results.

Discussed that only fitted distributions were provided in Form S-3. Reviewed revised Form S-3 to include all probability distributions impacting the stochastic model.

Reviewed consistency of results across all related forms.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

2. Form S-6 will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Verified no changes from the previous submission and no new sensitivity tests were required or performed.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

2. Form S-6 will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Verified no changes from the previous submission and no new uncertainty tests were required or performed.

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

35. S-4, page 311: Provide explicit calculations that demonstrate that the standard errors are less than 2.5% of the average loss costs for each county.

Verified: YES

Professional Team Comments:

Reviewed county level calculations demonstrating that the standard errors are less than 2.5% of the average loss costs for each county.

S-5 Replication of Known Hurricane Losses*

*(*Significant Revision)*

The model shall estimate incurred losses in an unbiased manner on a sufficient body of past hurricane events from more than one company, including the most current data available to the modeling organization. This standard applies separately to personal residential and, to the extent data are available, to commercial residential. Personal residential experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail and shall include loss data from both 2004 and 2005.

Audit

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

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

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

4. Form S-4 will be reviewed.

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

Pre-Visit Letter

39. Form S-4, page 320: Of the 22 comparisons, 19 have modeled ratios larger than actual ratios. Respond to potential bias these results suggest.

40. Form S-4, page 323: Scatterplot for Comparison #5 must be redone.

Verified: YES

Professional Team Comments:

Reviewed Form S-4 comparisons and determined that they were not randomly picked from the available data. Although the five comparisons potentially suggest a bias, consideration of Table 29 ameliorated this concern. Reviewed revised scatter plot for comparison #5.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-5 will be reviewed for consistency with Standard G-1, Disclosure 5.

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

Verified: YES

Professional Team Comments:

Reviewed Form S-5 for consistency with overall submission.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation*

*(*Significant Revision)*

A. Model functionality and technical descriptions shall be documented formally in an archival format separate from the use of letters, slides, and unformatted text files.

B. The modeling organization shall maintain a primary document binder, containing or referencing a complete set of documentation specifying the model structure, detailed software description, and functionality. Development of the documentation shall be indicative of accepted software engineering practices.

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

D. The modeling organization shall maintain (1) a table of all changes in the model from the previously accepted submission to the initial submission this year and (2) a table of all substantive changes since this year's initial submission.

E. 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 or reference full documentation of the software.

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

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

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

5. Provide verification that documentation is created separately from and is maintained consistently with the source code.

6. The tables specified in C-1.C that contain the items listed in Standard G-1, Disclosure 5 will be reviewed. The tables shall contain the item number in the first column. The remaining five

columns shall contain specific document or file references for affected components or data relating to the following Computer Standards: C-2, C-3, C-4, C-5, and C-6.

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

Pre-Visit Letter

41. C-1.B, page 333: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 (page 98) by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Reviewed the process identified in 2011 (previous audit of this model) to improve the development and verification of the model (6 items listed in the Professional Team's 2011 report). Reviewed implementation of the corrective measures for mitigation of errors in the Florida Public Hurricane Loss Model after the last Professional Team on-site review. Verified the use of pair programming, improved inter-specialization communication, once a month face-to-face technical meetings, assignment of personnel for coordinating technical tasks across different groups, improvement of time deadlines, and the use of a subversion repository for data management.

Reviewed minutes for a few technical meetings.

Reviewed the primary document binder and several related binders corresponding to the Computer Science Standards.

Reviewed the table required in Standard C-1.D and subsequent revisions of the table during the audit, and verified that the item numbers on the left side of the table corresponded with 12 major changes to the model captured in response to Standard G-1, Disclosure 5.

.

C-2 Requirements

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

Audit

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

Pre-Visit Letter

42. C-2, page 335: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5 (page 98).

Verified: YES

Professional Team Comments:

Reviewed new requirements documentation reflecting each model change identified in Standard G-1, Disclosure 5 as well as the changes to the model that were identified during the audit that were missing from the initial submission.

Discussed the key role of requirements documentation added to the revised flowchart produced by the modeler in their on-site revision to Standard G-1.B.

C-3 Model Architecture and Component Design

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed flowcharts describing process flow involving functional software components as well as interactions among modeler personnel.

Emphasized with the modeler the importance of following procedures when producing flowcharts: a) adherence to a flowchart standard for all flowcharts, whether internal to the modeler's organization or public, b) differentiating control versus data flow in the flowchart, and c) full labeling of all flowchart components, including the nodes and arrows. The Professional Team pointed to Figure 16 and Figure 18 as examples that required clarification. These figures were updated in the submission.

Verified that flowcharts are control flow, rather than data flow, charts. Verified that the modeler's use of joins (i.e., where two control flows merge) and forks (i.e., where two control flows split) represent semantics associated with concurrent processes.

Reviewed the flowchart corresponding to the 30-year roof retrofitting. The Professional Team observed four errors in that flowchart, and reviewed the corrected flowchart version to reflect a 30 year, rather than 20 year, duration value for a roof.

Reviewed the flowchart corresponding to the model change for identifying ZIP Codes corresponding to a new wind-borne debris region (WBDR) map.

Reviewed the change of planetary boundary layer (PBL) from 500 to 450 meters over water, as indicated in a modeler illustration.

Reviewed flowchart for expected building loss. Two corrections were made to bring the flowchart into agreement with the computer code.

C-4 Implementation

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

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

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

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

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

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

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

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

Audit

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

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

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

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

5. The following information shall be available and will be reviewed for each component, either in a header comment block, source control database, or the documentation:
    a. Component name,

b. Date created,
c. Dates modified and by whom,
d. Purpose or function of the component,
e. Input and output parameter definitions.

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

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

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

Verified: YES

Professional Team Comments:

Reviewed the C++ implementation corresponding to the 30-year roof retrofitting. The Professional Team observed four errors in the model design component (reference Standard C-3) did not indicate a corresponding problem with the code, which was correctly implemented to capture a 30-year value for roof duration.

Reviewed the C++ implementation corresponding to the model change for identifying ZIP Codes corresponding to a new wind-borne debris region (WBDR) map. This procedure involved the Engineering team providing the Computer Science team with a WBDR map, and then the Computer Science team's geographical information system (GIS) implementation of ZIP Code based retrieval.

Verified the correspondence between a) the rows and columns identified by Tables 5 and 22 in the submission and b) the rules encoded in a SQL script.

Reviewed assignment rules of vulnerability matrix depending on data availability in insurance portfolios.

Reviewed the table required by Standard C-4.D.

Reviewed the computer code change of planetary boundary layer (PBL) from 500 to 450 meters over water.

Discussed the equation table required by C-4.F by reviewing the commercial residential expected damage functions for low-rise and mid-to-high rise expected loss calculation equations for specific risks.

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

Reviewed the computer code for executing and compiling Form A-4 (Output Ranges) results.

C-5 Verification*

*(*Significant Revision)*

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

2. The testing software used by the modeling organization will be reviewed.

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

4. Crosschecking procedures and results for verifying equations will be reviewed. Examples include mathematical calculations versus source code implementation, or the use of multiple implementations using different languages.

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

6. The response to Disclosure 1 will be reviewed.

Pre-Visit Letter

43. C-5, page 339: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5 (page 98).

Verified: YES

Professional Team Comments:

Reviewed the verification method used by the modeler to ensure correct implementation of the wind-borne debris region in terms of corresponding ZIP Codes.

Reviewed various instances of cross-checking procedures employed by the modeler.

Reviewed Excel spreadsheet to cross-check matrix assignment through to loss costs.

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

Reviewed the computer code and regression tests completed on Form A-4 (Output Ranges) demonstrating agreement between the results from the November 2012 submission and the rerun output ranges.

C-6 Model Maintenance and Revision

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

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

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

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

Audit

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

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

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

Pre-Visit Letter

44. C-6.D, page 342: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

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

Professional Team Comments:

Discussed with the modeler their use of SVN (Apache Subversion) for managing changes to both documentation and source code. Later in the audit, verified that for some of the model source code, tracking software was not used. The modeler specified that they had used SVN since model version 4.1, but it was not used uniformly or completely in the current submission. In particular, one piece of code involving wind speed correction was changed in July, 2012, but not subsequently tracked prior to the submission date. Thus, the Professional Team was unable to verify Standard C-6.C. The Professional Team will

not be able to verify Standard C-6.C until the requirements for this standard are met by the modeler. These requirements include that the modeling organization shall use tracking software to identify all errors, as well as modifications to the code, data, and documentation.

Discussed with the modeler that the model build used for the November 2012 submission was developed and run outside the SVN framework. Discussed that this allows for the possibility that the model used for the submission and the model in the SVN archive could be different.

Reviewed model version history of the past 5 years. This history was specified in a history of changes from one model version to the subsequent model. The following change documents were reviewed: 1) 2.0 to 2.5, 2) 2.5 to 2.6, 3) 2.6 to 2.7, 4) 2.7 to 3.0, 5) 3.0 to 3.1, 6) 3.1 to 4.0, 7) 4.0 to 4.1, and 8) 4.1 to 5.0 (current version).

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

Discussed that for the previous submission, there was an inconsistent use of version control for model components such as source code and documentation.

Reviewed a revised procedure, updated during the audit, to ensure that all software used to implement the model is saved and managed in version control system by all teams.

Discussed the design and implementation associated with how model teams coordinate their updates to version control to avoid potential conflicts when one model component is simultaneously edited by more than one team member.

Verified that the policy for model revision was updated to account for the new version control system by all teams.

Verified no change in Form A-4 (Output Ranges) since the prior visit, and the subsequent uniform implementation of version control.

Reviewed the written minutes of two meetings held in February 2013 associated with adherence to version control compliance.

Reviewed training documentation provided by the Computer Science team on the approach to version control. Discussed that there were no archival materials in training other than the version control functionality document.

Discussed the use of shell scripts to assist in automating the procedures required for creating forms for the model submission.

C-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no changes to security policy and verified that the modeler has not encountered any issues since the last accepted submission.