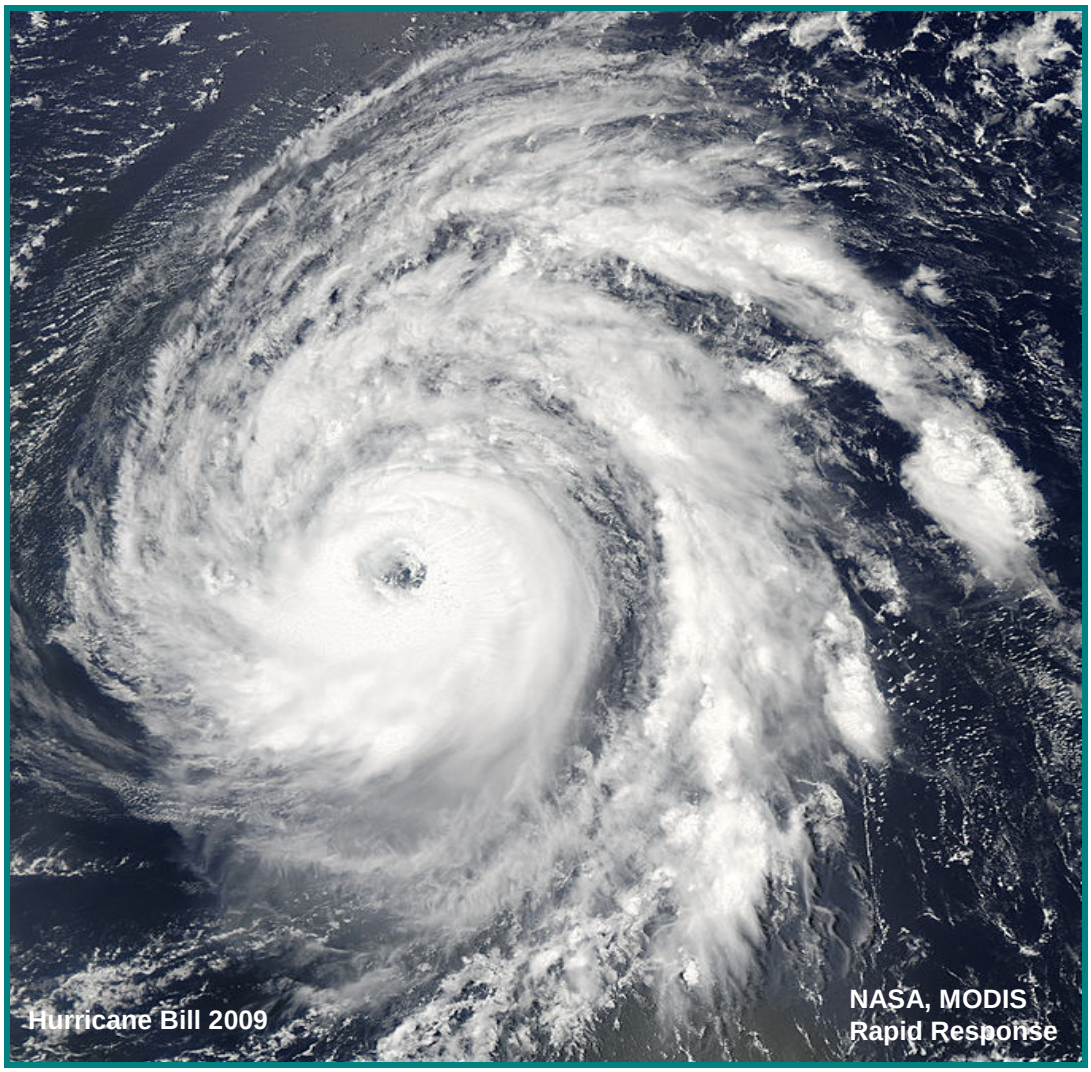
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2009 Standards

Florida Public Hurricane Loss Model
Florida International University

On-Site Review
March 14-17, 2011

Additional Verification Review
June 6 & 7, 2011

On March 14-17, 2011, the Professional Team conducted an audit on-site at Florida International University (FIU) in Miami, Florida. The following individuals participated in the review:

FIU

Bachir Annane, Senior Research Associate III, CIMAS/HRD
Shu-Ching Chen, Ph.D., Associate Professor, School of Computing and Information Science, Florida International University
Steve Cocke, Ph.D., Associate Scholar/Scientist, Department of Meteorology and COAPS, Florida State University
Jennie Dautermann, Ph.D., Instructor of Professional and Technical Writing, Department of English, Florida International University
Gail Flannery, FCAS, MAAA, Consulting Actuary, AMI Risk Consultants, Inc.
Fausto Fleites, B.S., Student Programmer and Ph.D. Candidate, Florida International University
Sneh Gulati, Ph.D., Professor, 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, B.S., Student Programmer and 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
Ronald Ocampo, B.S., Student Programmer and Ph.D. Candidate, 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

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

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

On March 2, 2011, FIU notified the Commission they had "discovered several errors in the forms and some of the disclosures that were submitted in November 2010," and stated that the model was "not affected and the problems [were] confined to the submission process." The following revised forms and responses were submitted along with an explanation of the errors, their genesis, and the corrective actions taken:

- Expert Certification Forms G-1 (General Standards), G-2 (Meteorological Standards), G-4 (Actuarial Standards), G-5 (Statistical Standards), and G-6 (Computer Standards)
- Form M-2 (Maps of Maximum Winds)
- Form A-1 (Personal Residential Loss Costs)
- Form A-2 (Zero Deductible Personal Residential Loss Costs by ZIP Code)

- Form A-3 (Base Hurricane Storm Set Statewide Loss Costs)
- Form A-4 (Hurricane Andrew (1992) Percent of Losses)
- Form A-5 (Cumulative Losses from the 2004 Hurricane Season)
- Form A-6 (Personal Residential Output Ranges)
- Form A-7 (Percentage Change in Personal Residential Output Ranges)
- Form A-8 (Percentage Change in Personal Residential Output Ranges by County)
- Form A-9 (Probable Maximum Loss for Florida)
- Form S-2 (Examples of Loss Exceedance Estimates)
- Form S-4 (Validation Comparisons)
- Form S-5 (Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled)
- Standard G-1, Disclosure 5
- Standard A-2, Disclosure 3
- Standard A-6, Disclosure 1
- Standard A-7, Disclosures 2 and 4
- Standard A-9, Disclosures 1 and 2
- Standard A-10, Disclosure 2
- Standard S-5, Disclosure 1

FIU opened with an explanation of the errors that occurred in the initial submission, their genesis, and corrective actions implemented to prevent similar errors from occurring in the future.

Error #1 was the use of an outdated version of the statistics used to generate random year built values in the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data. This error was corrected by updating the statistics and regenerating random year built values in the 2007 FHCF exposure data. Corresponding forms that utilize the 2007 FHCF exposure data were regenerated. FIU stated that communication improvements would be made between the engineering and computer science teams to prevent this type of error from occurring in the future.

Error #2 was a scripting error in the post processing of Form A-6 that caused ZIP Code level loss costs to not be properly weighted by the number of insured risks. This error was corrected by modifying the script that updates the number of insured risks for calculating the weighted average loss costs at the ZIP Code level. Forms A-6, A-7 and A-8 were regenerated. Corrective action implemented will be to use pair programming for development and verifying complicated source codes.

Error #3 was the use of the wrong number for the years of simulation used to compute loss costs in Form A-1. The error was corrected by rerunning Form A-1 with the correct number for years of simulation. Corrective action implemented is to use pair programming practice.

Error #4 was the use of a corrupted file in a windspeed correction run for the base storm set which caused missing wind data in some of the base set storms. This error was confined to the base storm set, not to the stochastic storm set. This error was corrected by re-running the windspeed correction code for the base storm set and modifying the script that reads the storms dates. Corresponding forms that utilize the base storm set were regenerated. Corrective action implemented is to use pair programming practice.

The review then focused on the changes in the model from the previous submission.

The Professional Team was unable to verify standards M-3 (Hurricane Probabilities), V-1 (Derivation of Vulnerability Functions) and S-1 (Modeled Results and Goodness-of-Fit) due to several issues and questions raised regarding the underlying data that support the distribution fits for rainfall rate and duration relating to commercial residential loss cost generation. Consequently, Standards G-1 (Scope of the Computer Model and Its Implementation), G-4 (Independence of Model Components), G-5 (Editorial Compliance), A-1 (Modeled Loss Costs and Probable Maximum Loss Levels), A-2 (Underwriting Assumptions), A-5 (User Inputs), A-6 (Logical Relationship to Risk), A-9 (Time Element Coverage), A-10 (Output Ranges), A-11 (Probable Maximum Loss), S-5 (Replication of Known Hurricane Losses), S-6 (Comparison of Projected Hurricane Loss Costs), C-4 (Implementation), and C-5 (Verification) also could not be verified as they require the verification of the aforementioned three standards. At the exit briefing, modeler options as given in the Report of Activities were presented to the modeler.

The Professional Team was presented with, and discussed, a comprehensive approach to improving the development and verification of the model, and its corresponding implementation, using the following:

- Enhancement of inter-specialization communication using internet communication technologies such as video conferencing
- Improvement in the organization of the model by having more face-to-face technical meetings with a greater participation of members from all specialization teams
- Assignment of personnel for the responsibility of coordinating technical tasks across different teams
- Movement of time deadlines for submission of model components to an earlier date in order to ensure a more thorough integration and verification of the model
- Improvement in the data management process by requiring all teams to store more data in a Subversion repository and implementation of an automatic notification mechanism

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

- Page 23 – corrected county statistics in sampling plan
- Page 25 – Figure 8 revised
- Page 26 – Table 1 revised
- Pages 28 & 29 – revised to clarify internal pressure as it relates to Table 2 and Table 3
- Page 34 – corrected number of counties in exposure survey
- Page 35 – corrected legend in Figure 11
- Page 36 – revised to include reference to Table 5
- Page 39 – revised to clarify retrofitting applies to roof only and revised Table 6
- Pages 41 & 51 – corrected number of counties in commercial residential survey
- Page 47 – revised to clarify rain rate assigned for interior damage
- Page 56 – Figure 18 corrected to remove bullet item “Quantifies wind resistance” under Actuarial Loss Module
- Page 68 – revised to include HAZUSMH MR3 Hurricane Model Technical Manual in references
- Page 88 – revised label for leak model percentage changes
- Page 95 – revised to add Dr. Jennie Dautermann
- Page 116 – revised to define variables on axes and to clarify caption for Figure 23

- Page 122 – revised statement on treatment of vertical winds
- Pages 137 & 138 – Form M-1 and Figure 30 revised
- Page 141 – Form M-2A revised
- Page 166 – revised to clarify Dr. Jiang's affiliation and to clarify source of the rain rate data
- Page 167 – revised to include correct Figure 41 and text on rainfall duration data clarified
- Page 168 – revised to clarify rain rate assigned for interior damage under disclosure 4 and to add reference to Table 1 under disclosure 5
- Page 171 – revised to clarify retrofitting applies to roof only and revised Table 21
- Page 185 – revised to correct figure number references in text
- Pages 238-240 – Form A-3 revised
- Page 313 – revised to correct number of simulations and table number
- Page 329 – Form S-3 revised to include rain rate distributions

Just prior to the November 15, 2011 submission, an error in treating year built for mobile homes in the previous submission was discovered. Year built was treated as missing leading to an overall weighted average vulnerability function. The error in mapping of the year built in the FHCF exposure data did not have an effect on the use of the model for individual companies. For the current submission, actual year built was incorporated for mobile homes, which is a better reflection of the building stock. This correction would have led to an approximate 7% change in mobile home loss costs. Informed modeler that this error falls under item VI.E. of the Report of Activities on page 50 and should have been reported to the Commission Chair as soon as it was discovered.

Additional Verification Review – June 6 & 7, 2011

FIU submitted revisions to the original November 15, 2010 and corrected March 2, 2011 model submissions under the 2009 Standards on April 22, 2011. The Professional Team completed the additional verification review on June 6 & 7, 2011 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
Jennie Dautermann, Ph.D., Instructor of Professional and Technical Writing, Department of English, Florida International University
Gail Flannery, FCAS, MAAA, Consulting Actuary, AMI Risk Consultants, Inc.
Fausto Fleites, B.S., Student Programmer and Ph.D. Candidate, Florida International University
Sneh Gulati, Ph.D., Professor, Statistics, Florida International University
Kurt Gurley, Ph.D., Associate Professor, Department of Civil and Coastal Engineering, College of Engineering, University of Florida
Shahid Hamid, Ph.D., CFA, Professor, Director of MSF Program, Florida International

University, Director 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
Ronald Ocampo, B.S., Student Programmer and Ph.D. Candidate, Florida International University
Jean-Paul Pinelli, Ph.D., Professor, Department of Civil Engineering, Florida Institute of Technology
Gonzalo Pita, M.S., Ph.D. Candidate, Florida Institute of Technology
Mark Powell, Ph.D., Senior Atmospheric Scientist, NOAA Hurricane Research Division, AOML

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

The additional verification review began with a discussion of the outstanding issues. FIU confirmed no additional changes were discovered or made since the April 26, 2011 revised submission. FIU began with a presentation on the impinging rain study used to estimate probability distributions of impinging rain conditioned on the peak 3-second gust and implemented in the vulnerability model damage matrices to account for water infiltration.

The Professional Team reviewed the Computer Standards related to the two major model changes:
1) Update of the rain estimation in the commercial residential model, and
2) Incorporation of time related expenses in the insured loss model for low-rise commercial residential.

In reviewing the revised rain estimation model, an apparent error was discovered in the code which was found to agree with the corresponding flow chart. Thus, the source of the error was in the flowchart; both the flowchart and code were to be revised. Upon further review, an additional flaw in the flowchart and corresponding code was discovered. All forms, figures and tables involving commercial residential exposures had to be revised to reflect the two corrections. The modeler estimated that it would take several hours to make the corrections and generate new forms, figures and tables.

The presentations on the rainfall model from both meteorological and vulnerability perspectives indicated the need for further elaboration in the submission. The modeler agreed to revise the submission accordingly.

In light of the discovery of the errors in the flowchart/codes, several additional exhibits and queries could not be provided until the following morning. The Professional Team agreed to arrive two hours early the next day to review this material.

The revised material and the requested exhibits were reviewed at the beginning of the second day of the audit. The large amount of material to be reviewed owing to the errors discovered on day one, precluded the Professional Team from reviewing all of the page changes, corrections of typographical errors, and conformance with the revision protocols called for in the Report of Activities.

All standards were able to be verified except for Standard G-2 (Qualifications of Modeling Organization Personnel and Consultants) and Standard G-5 (Editorial Compliance).

The Professional Team was unable to review on-site the additional corrections to be included in the revised submission which must be received by the State Board of Administration no later than 12:00 noon, Friday, June 10, 2011 in order for the Commission to have some time to review the material prior to the meeting on June 16, 2011 to review the model for acceptability.

Report on Deficiencies

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

1. Submission pdf document is not bookmarked by standard, form and section as required. In addition, on page 39 the pdf document does not agree with the printed document.

2. Standard G-1, Disclosure 5.B & C (page 84)
    a. Percentage difference in the average annual zero deductible statewide loss costs not provided for significant change #4.
    b. Color-coded map by county reflecting the percentage difference in average annual zero deductible statewide loss costs not provided for significant change #4.
    c. Maps provided on pages 86-90 not designated nor numbered as Figures and consequently not specifically listed in the Table of Contents.

3. Form A-6 (Appendix B, pages 365-398)
    Output Ranges as printed in the hard copy of the submission are unreadable

4. Form S-6 (pages 336-342)
    a. Contour plots in Figures 83-85 on pages 338-340 of the submission need to be reproduced using levels that reveal the distribution of loss cost over the entire area. These plots have been requested from the modeler.
    b. Standardized regression coefficients summary table not provided.
    c. Expected percentage reduction summary table not provided.
    d. Uncertainty analysis output files required to check the expected percentage reduction calculations not provided.

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

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

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

It is important that all material prepared for presentation during the on-site review be presented using a medium that is readable by all members of the Professional Team simultaneously. The Professional Team will review selected computer code in conjunction with the reviews performed for each section. Computer code should be available in a format that will allow simultaneous visualization by the entire Professional Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Professional Team. The Professional Team should be provided access to an internet connection through one of the Professional Team member computers for reference work that may be required while on-site.
The presentation during the on-site review is recommended to proceed in the following sequence: (1) new, or updated, material related to the model; (2) responses to the pre-visit letter questions and issues; and (3) responses to the audit items for each standard in the Report of Activities.

Be prepared to provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and 2005 hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data. Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2007 FHCF exposure data.

When the Professional Team arrives on-site, provide the electronic file used to complete Form V-3 on a removable drive medium. The electronic file will be used during the on-site review and will be returned when the on-site review is complete.

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

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

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

GENERAL STANDARDS – Mark Johnson, Leader

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

*(*Significant Revision)*

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

Audit

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

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

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

Pre-Visit Letter

1. G-1, Disclosure 2, pages 23-52: Be prepared to describe various models in the vulnerability component of the model, including the following aspects:
    a. Pages 23-24: Explain the sampling plan used for the Florida building stock survey. Describe the exposure study results and distributions for various regions and compare with the previous submission.
    b. Page 26, Table 1: Describe the basic models in relation to the six key parameters mentioned on page 24 (e.g., roof cover, roof shape, exterior wall material, number of stories, year built, and building area.)
    c. Page 27: Clarify modeling of windspeed as a random variable for developing damage matrices.
    d. Pages 28-30: Clarify Table 2 with regards to internal pressure as a structural component in developing damage matrices and why internal pressure is not modeled for manufactured homes in Table 3.
    e. Page 31: Describe modeling of utility damage estimation under a complete loss to the structure.
    f. Page 35: Describe what is meant by V4.1 on Figure 11.
    g. Page 36: Describe "other" and "unknown" designations.
    h. Page 36: There is no reference to Table 5 in the text.

i. Page 39: Provide basis for Table 6 and specifically why Pre-1960 constructions perform better than 1960-1970 constructions located in the HVHZ region and designation of strong to all post 2002 constructions in all regions.
j. Page 41: Provide the 23 counties used in the exposure study.
k. Page 43: Define mid-rise and high-rise buildings.

2. G-1, Disclosure 3, page 56: Describe the quantification of wind resistance under the Actuarial Loss Module in Figure 18.

3. G-1, Disclosure 5.B & C, page 85: Provide the percentage difference in average annual zero deductible statewide loss costs and color-coded maps by county of the percentage difference resulting from (1) the new HURDAT database and (2) the new 2009 ZIP Codes.

4. G-1, Disclosure 5.C, pages 86-90: Be prepared to discuss the maps provided.

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Reviewed the sampling plan for the Florida building stock survey used to develop the building models that represent the majority of Florida residential building stock. The sampling plan included property appraiser databases for 33 counties. Reviewed the building component attributes collected in the survey. Reviewed the results of the building components survey for the three Florida wind sub-regions of High Velocity Hurricane Zone, Wind Borne Debris Region, and Inland Region.

Discussed the year built dependency tests performed. The final content of the database includes statistical data for different eras with conditional probabilities. Reviewed comparisons of the current survey (2009, version 4.0) statistics to the previous survey (2002, version 3.1) statistics. Enhancements included 33 counties surveyed compared to 9 previously, statistical data at the regional and county level, conditional probabilities, and statistical data inside each era. Reviewed examples of differences in summary statistics among the surveys for Brevard, Broward, Hillsborough, and Pinellas counties for exterior wall, roof over, and roof shape and for Florida residential construction building type for the Keys, South, Central, and North Florida regions.

Discussed the differences between the building parameters physically modeled for building exterior for the basic categories of models – weak, medium, and strong provided in Table 1 of the submission.

Discussed modeling of windspeed as a random variable. Reviewed example where performing simulations of damage for a 3-second reference windspeed of 100 mph, each simulation applies loads based on a randomized sample with mean 100 mph and 10 mph standard deviation. This technique is used due to the inherent uncertainty concerning the value of the maximum sustained 3-second gust windspeed occurring at the location of the simulated building due to approach terrain, mean roof height, and local obstructions.

Discussed the damage matrices for site-built homes including the 15 model components in Table 2 with the exception of internal pressure.

Discussed modeling of utility damage estimation under a complete loss to the structure. Damage to the electric, mechanical, and plumbing is proportional to the interior damage. Reviewed scatter plots comparing electrical, mechanical, and plumbing damage ratios to the percentage of sheathing loss.

Reviewed the definitions for "other" and "unknown." Buildings are classified as "unknown" if the information is not specified or missing.

Discussed the basis for Table 6 and the reasons why the pre-1960 constructions perform better than 1960-1970 constructions located in the MVHZ region. The designation of strong to all post 2002 constructions in all regions is due to the Florida Building Code requirements and no differentiation in the model within the strong category.

Reviewed the 21 counties included in the survey of commercial residential buildings for low-rise and mid-high rise buildings. Discussed low-rise buildings being very similar to single-family homes where mid-high rise buildings are very different to single-family homes. In modeling low-rise buildings, the building is modeled as a whole. In modeling mid-high rise buildings, the building is treated as a collection of apartment or condominium units.

Discussed and reviewed correction to Figure 18, Flow Diagram of the Computer Model, in the Actuarial Loss Module section to remove bullet item "Quantifies wind resistance."

Reviewed color-coded maps by county of the percentage difference in average annual zero deductible statewide loss costs resulting from the new HURDAT database and the new 2009 ZIP Code database.

Reviewed the following changes to the meteorological component of the model. The windfield model did not change.

- New terrain conversion and vertical profile of windspeed
- New coastal transition based on internal boundary layer growth
- Population weighted ZIP Code roughness
- Inclusion of water management district land use land cover classifications

Discussed the impact of these changes.

The coastal transition function allows for stronger winds in coastal ZIP Codes for situations with an upstream marine exposure. Inland ZIP Codes generally have larger upstream effects of higher roughness, i.e., weaker winds. Reviewed the largest increase in ZIP Code 33019 that moved closer to the coast and the largest decrease in ZIP Code 33606 that moved further inland.

Reviewed the coastal transition function curve with percentage transition from marine to local roughness.

Discussed the county wide percentage change in loss costs due to the new statistics in the building population. The increase in most counties is around 2% with only a few counties have differences more than 3%. More wood frame buildings were observed in the new statistics resulting in an increase in the total damage. The largest increases in wood frame were in Escambia, Okaloosa, Miami-Dade, and Monroe counties. Reviewed example of changes in the vulnerability curve due to the new statistics in the South region.

Discussed the county wide percentage change in loss costs due to the adjusted leak model for personal residential structures. Verified there is not a brand new leak model, rather the leak model for the Central and North wood frame vulnerabilities was adjusted to ensure a smoother transition between damage governed by water leaks and damage governed by wind damage, as the windspeed increases. The adjustment also reflects that there is a higher probability of leak-induced damage in wood frame structures than in masonry structures. The leak model was not changed for the Keys or the South regions.

Reviewed graphical comparison of adjusted leak model vulnerability curve to the previous submission's curve.

Discussed the county wide percentage change in loss costs of an approximate 12% increase due to new statistics, new eras, and new non-retrofitted vulnerability matrices. Reviewed examples of the differences in old and new statistics due to new eras on the effect of strength for the Keys, Seminole county in the Central region, Escambia county in the North region, and Miami-Dade county in the South region.

Reviewed graphical comparison of changes in the vulnerability curve for the South region to the previous submission's curve.

Reviewed the two new models introduced due to retrofitting being more prevalent in the South due to the implementation of the South Florida Building Code post Hurricane Andrew (1992).

Additional Verification Review Comments

Reviewed implementation of the impinging rain study used to estimate probability distributions of impinging rain conditioned on the peak 3-second gust. A Monte Carlo simulation for exterior damage is used to compute the vulnerability function using rain log normal distributions (Marks et al, 1993) with:

- NOAA Hurricane Research Division's R-CLIPER model to estimate free-falling rain rates in a hurricane, Lonfat et al (2007)
- Holland B type wind model for mean horizontal wind
- Dingle and Lee (1972) to estimate terminal velocity
- Willis and Tattleman (1989) for rain drop distribution
- 100,000 storms simulated with 91 station locations in each storm.

G-2 Qualifications of Modeling Organization Personnel and Consultants

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

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

Audit

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

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

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

Pre-Visit Letter

5. G-2, Disclosure 1.D, page 92: Provide details relating to the firms and organizations in the insurance and reinsurance industry for whom the modeler is providing services.

6. G-2, Disclosure 2.B, page 95: Provide the resumes of new personnel working on the model or acceptability process who were not involved at the time of the previous Professional Team review.
    a. Bobak Torkian
    b. Timothy Johnson
    c. Johann Weekes
    d. Juan Antonio Balderrama
    e. Yimin Yang
    f. Chao Chen
    g. Antonio Hudson

h. Kathy Fearon
i. Diane Ripandelli

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

Professional Team Comments:

Reviewed resumes of new personnel:

- Juan Antonio Balderrama Garcia Mendez, Ph.D. candidate in Structural Engineering, University of Florida; M.E. in Structural Engineering, University of Florida; B.S. in Civil Engineering, University of Notre Dame
- Timothy Johnson, M.S. candidate in Civil Engineering, Structures, Florida Institute of Technology; B.S. Civil Engineering, Florida Institute of Technology
- Boback Bob Torkian, Ph.D. candidate, Florida Institute of Technology; M.S. in Civil Engineering, Florida Institute of Technology; B.S. in Civil Engineering, Zanjan State University, Iran
- Kathy Fearon, Education Specialist, Florida State University; M.A. English, Middlebury College; B.A. English, Florida State University
- Johann Everton Christopher Weekes, Ph.D. candidate in Structural Engineering, University of Florida; M.E. in Construction Management, University of Florida; B.S. in Civil Engineering, University of Florida
- Diane Ripandelli, B.A. English, Florida State University
- Antonio Hudson, M.S. candidate in Statistics, Florida International University; B.S. in Industrial & Systems Engineering and Mathematics, Florida International University
- Chen Chao, Ph.D. candidate in Electrical and Computer Engineering, University of Miami; M.S. Engineering, Shanghai Jiaotong University, China; B.S. Engineering, Southeast University, China
- Yimin Yang, Ph.D. candidate in Computer Science, M.S. Engineering, Xidian University, Xi'an, China; B.S. Engineering, Xidian University, Xi'an, China
- Jennie Dautermann, Ph.D. English, Purdue University; M.A. English, Ohio State University; B.A. General Studies, Northwest Nazarene College, Nampa, Idaho

Discussed personnel changes since the previous submission.

Discussed the modeling services provided by FIU. In 2008 the Florida legislature passed a bill requiring FIU to provide model service directly to the insurance industry effective January 1, 2009. The computational capacity was expanded to provide the new service. Each client company enters into a contract with the FIU Research Foundation. To date, the model has been used by 28 companies. A fee is charged for the use of the model based on an approved fee structure adopted through the Florida rulemaking process. The fee depends on the output required and the number of records. Confidentiality of company input data is strictly maintained. The companies submit data as per the input data specification. The model provides average annual losses by policy or aggregated by requested criteria, losses by event for hurricanes in the stochastic set, and the PML for personal residential policies. The Florida Office of Insurance Regulation is the largest client.

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

Expert Certification Forms are required upon completion of all editorial changes.

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.

Information to be presented to the Professional Team:

- G-3.C, page 99 – Maps showing the ZIP Code boundaries and the associated centroids will be provided to the professional team during the on-site visit.

Pre-Visit Letter

7. G-3, page 99: Be prepared to review the updated ZIP Code centroids in detail.

Verified: YES

Professional Team Comments:

Reviewed new versus old centroids throughout Florida and the updating process used.

Reviewed histogram of centroid differences between 2008 and 2009 ZIP Codes era data.

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 M-3, V-1, and S-1.

*****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 M-3, V-1, and S-1.

G-5 Editorial Compliance

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

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2009*.

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

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

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

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

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

7. Form G-7 will be reviewed.

Verified: NO

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

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

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

Due to an excessive number of outstanding editorial issues, the Professional Team was unable to verify Standard G-5. Numerous editorial issues have been prevalent throughout the review process.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 7, 2009 (or later). Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

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

Audit

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

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

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

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

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

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

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

Information to be presented to the Professional Team:

- Form M-1, page 133 – A report detailing the [historical] counts will be available for review.

Verified: YES

Professional Team Comments:

Discussed that no short-term or long-term variations in annual hurricane frequencies are incorporated into the model. The modeled frequencies are based on the HURDAT database identified in the submission.

Reviewed the file documenting the modeler's Base Hurricane Storm Set. Discussed the changes in HURDAT for 1920-1925 storms due to the ongoing Reanalysis Project. Reviewed a revised methodology for incorporation of revisions to existing storms into the Base Hurricane Storm Set using versioning.

Reviewed a revised flowchart illustrating how changes in the HURDAT database are incorporated into the generation of the stochastic storm set.

Reviewed changes to the modeling organization's Base Hurricane Storm Set from the previously accepted submission. Inconsistent inclusion of by-passing 2008 Hurricanes Gustav and Ike in Form A-3 but not in Forms M-1 and M-2 was discussed.

Reviewed revised versions of Forms M-1, M-2 and A-3.

Discussed the revised histogram (Form M-1) for by-passing hurricanes.

Reviewed Forms M-1 and S-1 for consistency. Verified that Form S-1 does not include by-passing storms.

M-2 Hurricane Parameters and Characteristics*

*(*Significant Revision)*

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

Audit

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

2. Prepare graphical depictions of hurricane parameters as used in the model. Describe and justify:

   - The data set basis for the fitted distributions,
   - The modeled dependencies among correlated parameters in the windfield component and how they are represented,
   - The asymmetric nature of hurricanes,
   - The fitting methods used and any smoothing techniques employed.

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

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

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

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

Pre-Visit Letter

8. M-2, Disclosure 1, page 112: Describe how the use of Rmax and Pmin at landfall impact the spatial variation of the windfield for by-passing hurricanes.

9. M-2, Disclosure 5, Figure 23, page 116: Define variables on axes for the two plots and clarify caption.

10. M-2, Disclosures 5 & 9, pages 116-117: Clarify whether the over-water slab boundary layer depth is 450 m or 500 m.

Verified: YES

Professional Team Comments:

The spatial variation of the windfield for by-passing storms is the same as for landfalling storms. Rmax for all storms are sampled from a distribution based on historical landfall Rmax and Pmin.

Reviewed a revised Figure 23 to reflect consistent data in both panels and to update the caption to include definitions of all variables.

Verified that the over-water slab boundary layer depth is 450 m and that a boundary layer depth of 500 m is used for calculation of top of the boundary layer winds at the coast (marine exposure 10-minute wind).

Discussed treatment of the inherent uncertainty in the conversion factor used to calculate surface winds.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

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

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

Saffir-Simpson Hurricane Scale:

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

Audit

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

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

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

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

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

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

Professional Team Comments:

Problems with the leak model described in Professional Team comments for Standard S-1 mean that Standard M-3 cannot be verified since the rain rate and duration distributions are hurricane characteristics simulated by the model.

Reviewed a revised flowchart illustrating how changes in the HURDAT database are used in the development of probability density functions (pdfs) for changes in translation speed and direction, and for hurricane intensity.

Reviewed Form S-3. Verified that information on the distributions and data sources for the rain rate and duration will be included in a revised Form S-3.

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

Reviewed development of the meteorological component of the impinging rain model contributing to mid/high rise damage.

Documentation reviewed:

- Dingle, A.N., and Lee, Y. (1972): Terminal Fall Speeds of Raindrops, *Journal of Applied Meteorology*, Vol. 11, August, pp. 877-879.
- Lonfat, M. F.D. Marks, Jr., and S.S. Chen (2004): Precipitation Distribution in Tropical Cyclones Using the Tropical Measuring Mission (TRMM) Imager: A Global Perspective, *Monthly Weather Review*, 132, 1645-1660.
- Lonfat, M., R. Rogers, T. Marchok, and F.D. Marks, Jr. (2007): A Parametric Model for Predicting Hurricane Rainfall, *Monthly Weather Review*, 135, 3086-3097.
- Willis, P.T. and Tattleman, P. (1989): Drop-Size Distribution Associated with Intense Rainfall, *Journal of Applied Meteorology*, 28, 3-15.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

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

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

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

Audit

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

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

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

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

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

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

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

8. Form M-2 will be reviewed.

Pre-Visit Letter

11. M-4.C, page 120: Be prepared to describe the functional form used for the coastal transition.

12. M-4, Disclosure 4, page 122: Describe the treatment of vertical winds in the model.

13. M-4, Disclosure 7, page 123: Be prepared to discuss the method for inclusion of the Florida Water Management District land use land cover database into the model.

14. M-4, Disclosure 10, page 123: Be prepared to discuss the differences between the spatial distribution of winds for historical storms compared to the previous submission.

15. Form M-2, pages 140-143: Be prepared to discuss how maps that define white with two ranges are to be interpreted. Provide larger maps for Figures 33 and 34.

Verified: YES

Professional Team Comments:

Reviewed a modeler presentation outlining their evaluation of the Multi-Resolution Land Characteristics Consortium (MRLC) land use land cover (LULC) database. Discussed the development of a decision matrix for merging of the Florida Water Management District LULC database into the model. Reviewed examples of locations (Tallahassee airport, Lake Ella) with improved roughness values based on these changes.

Discussed in detail the method used to derive the functional form of the conversion factors used for the coastal transition of surface winds. Discussed that this approach reflects the development of an internal boundary layer at a roughness discontinuity.

Reviewed a revised Form M-2 (all maps) with new color bands. The modeler found a problem with missing HURDAT updates to their historical track base set used for Forms A-3 and M-2A. In the future the modeler will include the historical track base set, landfall and by-pass count tables, and HURDAT in a common versioning system and institute difference checks compared to the Report of Activities required version of HURDAT. Form M-2A was revised on-site to include Hurricanes Gustav and Ike (2008) as well as incorporating updates to the other (1920-1925) historical storms impacted by a database error. Reviewed new Form M-2A.

Discussed the differences between the spatial distribution of winds for historical storms in Form M-2A compared to the previous submission. Discussed the change in location of the actual terrain historical windspeed maximum between the previous and current submission. Discussed the likely relative contribution of the revisions to the coastal transition and treatment of roughness compared to the direction of hurricane winds for each storm. Reviewed a satellite image with landfall locations, ZIP Code centroid and Rmax locations for the 1935 hurricane (NoName2) and Hurricane Donna (1960).

Discussed that the use of gust factors for conversion between different averaging times (10-min, 1-min and 3-sec gust) is unchanged from the prior submission.

Discussed the development of a logarithmic vertical profile for modeled hurricane winds from the surface up to 150 m. Reviewed sample profiles for a variety of sustained surface winds and roughness values in the context of Form V-1.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

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

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Discussed that the model treatment of over-land decay is unchanged from the previous submission.

Reviewed Vickery et al. (2009) and discussed in detail how components of this paper were incorporated into the over-land surface windspeeds calculated in the model. Reviewed modeler presentation detailing the methodology used for developing conversion factor functions to calculate over-land winds from marine winds based on both transition zone and surface roughness. Reviewed implementation of this in the code.

Reviewed maps of roughness length and spatial distribution of (1-minute, 10-meter, actual terrain) windspeeds at landfall for Hurricane Dennis (2005) and Hurricane Andrew (1992). Discussed distribution of winds for Hurricane Andrew, including the impact of including the Florida Water Management District land use for roughness calculations, such as for a region of forested area inland in southern Florida. Discussed distribution of winds for Hurricane Dennis, including the impact of the new coastal transition zone treatment on winds on the barrier islands and in near-coastal waterways.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

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

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

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

Pre-Visit Letter

16. Form M-3, page 144: Be prepared to discuss the radii bounds and ranges compared to the previous submission.

Verified: YES

Professional Team Comments:

Discussed that the distribution of Rmax was unchanged from the previous submission. Discussed that the methodology used in filling out Form M-3 had changed from that used in the previous submission.

Discussed that the treatment of hurricane asymmetry was unchanged from the previous submission.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

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

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

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

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

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

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

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

Audit

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

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

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

4. Justify the construction types and characteristics used.

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

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

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

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

9. Form V-1 will be reviewed.

Pre-Visit Letter

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

17. V-1.B, page 149: In response to the new language in the standard, describe how the uncertainties associated with vulnerability functions were developed.

18. V-1.C, pages 149-150: In response to the new language in the standard, describe how the model accounts for variation of windspeed with height of buildings in the development of vulnerability functions. Provide plots of vulnerability functions and their uncertainty for low-rise, mid-rise, and high-rise constructions.

19. V-1, Disclosure 2, page 155: Be prepared to describe the use of loss data for hurricanes of 2005.

21. Form V-1, page 179: Account for differences between this year's submission and previous submissions.

22. Form V-1, pages 180-181: Explain the relationship of Figures 42 and 43 with the data provided in Part A.

Verified: ~~NO~~ YES

Professional Team Comments:

The methodology and data used to estimate hurricane rain rate and duration and subsequent rain entering building units was not ready to be reviewed. Consequently, the basis for damage induced by rain could not be established and as such Standards V-1, M-3, and S-1 could not be verified.

Reviewed the exposure study and survey for the building stock used to develop the building models that represent the majority of Florida residential building stock. The sampling plan included property appraiser databases for 33 Florida counties. Reviewed the building component attributes collected in the survey. Reviewed the results of the building components survey for the three Florida wind sub-regions: High Velocity Hurricane Zone, Wind Borne Debris Region, and Inland Region.

Discussed the year built dependency of building characteristics. The final content of the database includes statistical data for different eras with conditional probabilities for various building characteristics. Reviewed comparisons of the current survey (2009, version 4.0) statistics to the previous survey (2002, version 3.1) statistics. Enhancements included 33 counties surveyed compared to 9 previously, statistical data at the regional and county level, conditional probabilities, and statistical data for each era. Reviewed examples of differences in statistics between the surveys for Brevard, Broward, Hillsborough, and Pinellas counties for exterior wall, roof cover, and roof shape and for Florida residential construction building type for the Keys, South, Central, and North Florida regions.

Discussed the set of building parameter options assigned to each of the three building models (weak, medium, strong). Reviewed these options and modifiers as given in a revised Table 1.

Discussed in detail the application of the building code and the age classifications and categories per region shown in Tables 6 and 21 of the submission. The corresponding texts were revised to reflect the revisions in Tables 6 and 21. Discussed the process for determining if a building has been retrofitted for application of the appropriate damage matrices. The retrofit matrices are only applicable to the replacement of the roof covering and renailing of the roof decking.

Reviewed the source code for application of damage matrices. A programming implementation error was detected by the Professional Team in the Vulnerability component of the model. However, this particular coding error (1994 should have been 1993 to conform with the description in the submission) did not manifest itself in the output ranges owing to the discretization of year built in processing the FHCF exposure data. The source code was corrected.

Discussed how the uncertainties associated with the vulnerability functions were developed using probability distributions for uncertainties in windspeed, pressure coefficients, and exterior component capacities. Reviewed the associated coefficient of variations.

Discussed how the model accounts for variation of windspeed with height of buildings in the development of the vulnerability functions for low-rise and mid-high rise buildings. Low-rise buildings are defined as up to 3 stories and mid-high rise buildings are more than 3 stories.

Reviewed plots of commercial residential vulnerability curves for mid-high rise exterior damage.

Discussed modeler not having access to 2005 loss data yet.

Reviewed the development of commercial residential vulnerability functions. Reviewed selected results of mid-rise building surveys for year built and number of stories distributions. Reviewed examples of “closed” and “open” building characterizations for condominiums and apartment types according to location. Reviewed the modular approach for apartment/condo units not for the buildings themselves. Reviewed contribution of vulnerability models for building as a whole from unit vulnerability models.

Discussed differences between the commercial residential vulnerability model and the personal residential vulnerability model.

Reviewed flowchart of new interior damage model for commercial residential buildings.

Reviewed approach for interior damage model development due to rain infiltration. Reviewed interior damage ratio as a function of rain being based on published research and engineering judgment.

Reviewed flowchart for exterior and interior damage estimation for mid-high rise buildings.

Reviewed the flow chart for building vulnerability model selection according to its construction class, year of construction, and location. The flow chart was subsequently revised.

Reviewed the process for completing Form V-1 and the source code for calculating the losses.

Reviewed comparison of Form V-1 results to the previous submission. Discussed reasons for differences due to additional concrete construction and meteorological updates to model.

Discussed strong models by design windspeed in the current submission. Reviewed the parameters modeled. Discussed examples of the different levels of gradation for roof to wall connections.

Reviewed example of damaged mid-high rise buildings due to rain from Hurricane Frances (2004) in Satellite Beach where one building was unused for more than a year and repaired and another building was demolished.

Reviewed the plots in Figures 42 and 43 and discussed their differences.

Discussed commercial residential for unit owners does not include functions for time element coverage.

Discussed how the regional construction practices and period of construction impact the vulnerability functions.

Discussed variation of damage to a condominium/apartment unit per its location in a mid-high rise building (e.g., corner units versus middle units) and story level including top floor.

Reviewed Excel spreadsheet for vertical variation of winds for sample properties used in calculations for Form V-1.

Documentation reviewed:

- Jiang, H., Halverson, J., Simpson, J., Zipser, E.J. (2008). Hurricane "Rainfall Potential" Derived from Satellite Observations Aids Overland Rainfall Prediction. *Journal of Applied Meteorology and Climatology*, 47, 944-959.
- Sample of National Climatic Data Center station data for Florida hourly precipitation data for September 2004.

Additional Verification Review Comments

Reviewed implementation of the mean accumulated impinging rain as a function of peak 3-second wind gust.

Reviewed water penetration calculations for each component.

Reviewed formulation for water penetration computation as a function of amount of existing defects as well as breach of envelope. The corresponding formulation was then updated in the submission.

In course of reviewing the source code for implementation of water penetration calculations, two errors were discovered in the corresponding flowcharts and source code.

The first error was in the flowchart corresponding to the computation of water penetration for corner and middle units and combining the results. Both the flowchart and the source code were corrected.

The second error was in source code implementation of the water penetration calculation for units with outside entrance doors and units for inside entrance doors. The "outside" computation method had been implemented for both inside and outside, which was erroneous. The source code was revised and new vulnerability functions were developed for commercial residential low-rise and mid/high rise buildings. All affected Vulnerability (Form V-1), Actuarial (Forms A-3, A-4, A-5, and A-9) and Statistical Forms (S-2, S-4, and S-5) were revised accordingly.

Reviewed the adjustment factors basis and implementation. The corresponding text was revised in the submission to reflect what had been implemented.

Reviewed rain admittance factors (RAF), their basis and their implementation. The corresponding text in the submission was revised accordingly.

Discussed assumption of water percolation to lower stories at a rate of 12%.

Reviewed the interior damage approach for mid/high rise structures and low-rise commercial residential structures.

Reviewed revised results provided in Form V-1 for commercial residential structures.

Reviewed 20-story Form V-1 vulnerability function for concrete structure percolation values comparison.

Reviewed plot of damage ratios for the influence of water penetration for the 20-story Form V-1 concrete structure.

Reviewed table of leakage areas for low-rise residential ventilations and infiltration used as basis for defected area.

Verified no changes were made to the vulnerability functions for personal residential properties.

Reviewed plots of mid/high rise commercial residential vulnerability functions with and without the effects of the rainfall model.

Documentation reviewed:

- Straube, J.F. and Burnett, E.F.P. (2000): Simplified Prediction of Driving Rain Deposition, *Proceedings of International Building Physics Conference*, Eindhoven, pp. 375-382.
- Blocken, B. and Carmeliet, J. (2010): Overview of three state-of-the-art wind-driven rain assessment models and comparison based on model theory, *Building and Environment*, 45, 691-703.

V-2 Mitigation Measures

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

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

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

Audit

1. Forms V-2 and V-3 (Trade Secret List item) provide the information used in auditing this Standard.

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

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

Pre-Visit Letter

Provide the electronic file used to complete Form V-3 on a removable drive medium. The file will be used during the on-site review and will be returned when the on-site review is complete.

20. V-2, Disclosure 3, page 175: Provide evidence that wind mitigation features by policy are implemented in the model.

23. Form V-2, page 184: Account for differences between this year's submission and the previous submission.

24. Form V-3, page 187: Provide explanation of values for nailing of deck 8d versus the reference structure.

Verified: YES

Professional Team Comments:

Reviewed source code for applying wind mitigation features by policy.

Discussed the differences in Form V-2 results from the previous submission. For masonry, Form V-2 is the same. For wood frame, the results are different due to the changes to the leak model.

Discussed the use of two different approaches for application of the leak model for personal residential and commercial residential.

Reviewed vulnerability curves for the reference masonry structure in Form V-3. Discussed the application of mitigation features which might result in more damage at higher windspeeds.

Confirmed consistency between Form V-2 and Form V-3.

Discussed plan to apply new leak model approach to personal residential construction.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs and Probable Maximum Loss Levels*

*(*Significant Revision)*

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

Audit

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

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

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

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

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

A-2 Underwriting Assumptions*

*(*Significant Revision)*

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

B. For loss cost and probable maximum loss level estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) claim payment practices, (4) coinsurance, (5) contractual provisions, and (6) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be appropriate.

Audit

1. Demonstrate how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify model calculations. For example, the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.

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

Pre-Visit Letter

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Discussed no changes in the model to account for the impact of public adjusting on claims paid.

Discussed that while modeler believes some insurers may consider that in some cases damage above a certain percentage constitutes a total loss, the model does not incorporate this situation in their model calculations.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

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

*(*Significant Revision)*

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

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

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

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

Audit

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

Pre-Visit Letter

25. A-3, Disclosure 2, page 201: Provide evidence that the output ranges are calculated at the geocode level.

Verified: YES

Professional Team Comments:

Discussed the inputs into the loss cost calculations changed from policy ID and ZIP Code to policy ID and latitude/longitude.

A-4 Demand Surge*

*(*Significant Revision)*

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed no change to the application of demand surge to time element losses. Modeler uses the same demand surge procedure for commercial residential.

A-5 User Inputs

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

Audit

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

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

Information to be presented to the Professional Team:

- A-5, page 205 – The input format descriptions are available for audit.

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed model input forms for personal residential and commercial residential policies revised as directed by the Florida Office of Insurance Regulation.

A-6 Logical Relationship to Risk*

*(*Significant Revision)*

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

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

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

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

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

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

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

Audit

1. Graphical representations of loss costs by ZIP Code and county will be reviewed.

2. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.

3. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, and A-5 will be used to assess coverage relationships.

Pre-Visit Letter

26. A-6, Disclosure 1, Figure 47, page 217: Provide any correspondence between the modeler (or the Office of Insurance Regulation) and the insurer relating to the claim where the modeled losses substantially exceed the actual contents losses.

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Reviewed the process for completing Form A-1 and the resulting error in utilizing the incorrect number of years of simulation to obtain the average annual loss costs. Discussed new cross-check coding implemented to prevent this error in the future.

Discussed that no correspondence exists for the claim where the modeled losses substantially exceed the actual contents losses.

Discussed the process used to verify the loss costs relationships. Reviewed several e-mail correspondences resolving anomalies in loss costs produced.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed revised Forms A-3, A-4, and A-5 commercial residential results compared to the initial November 15, 2010 submission, the corrected March 2, 2011 submission, and the April 22, 2011 submission.

Reviewed revised Forms A-3, A-4, and A-5 results after correction of coding errors for corner/middle units and interior/exterior split in the commercial residential model.

A-7 Deductibles, Policy Limits, and Coinsurance*

*(*Significant Revision)*

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

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

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

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Discussed that there are no historical data available to the modeler for coinsurance penalties.

A-8 Contents*

*(*Significant Revision)*

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

No apparent changes from previous model version.

A-9 Time Element Coverage*

*(*Significant Revision)*

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

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

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

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

Audit

1. Documentation and justification of the following will be reviewed:
   a. The method of derivation and data on which the time element vulnerability functions are based;
   b. Validation data specifically applicable to time element coverages;
   c. Assumptions regarding the coding of time element losses by insurers;
   d. The effects of demand surge on time element for Hurricane Andrew (1992) and the 2004 and 2005 hurricane seasons;
   e. Assumptions regarding the variability of time element losses by size of property;
   f. Statewide application of time element coverage assumptions;
   g. Assumptions regarding time element coverage for mobile homes, tenants, and condo unit owners exposure;
   h. The methods used to incorporate the estimated time required to repair or replace the property;
   i. The methodology and available validation for determining the extent of infrastructure damage and its effect on time element costs.

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

No apparent changes from previous model version.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed incorporation of time element losses in the insured loss model for low-rise commercial residential.

Reviewed the low-rise commercial residential time element damage determination.

A-10 Output Ranges*

*(*Significant Revision)*

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

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

1. masonry construction versus frame construction,

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

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

4. in general, northern counties versus southern counties.

Audit

1. Forms A-6, A-7, and A-8 will be reviewed. The sample output range report produced by the model for commercial residential loss costs will be reviewed.

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

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

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

Pre-Visit Letter

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.

27. Form A-8, page 286: Be prepared to discuss individual counties whose percentage change is substantially larger than 9% (for example, Franklin County is greater than 100%).

28. Form A-7, unnumbered page following page 398: Be prepared to provide a detailed description of the loss cost changes in the output ranges from those in the previous submission, with particular attention to the following areas:
    a. Mobile Homes – all rows and columns
    b. Inland – all rows and columns
    c. Frame Owners North – all columns
    d. Frame Renters – all rows and columns

e. Masonry Condos – all rows and columns

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Reviewed the process for completing Form A-6 and the scripting error that led to incorrect weighting of loss costs by the number of insured risks. Reviewed the data file with the year built randomly applied for producing Form A-6. Reviewed the new/corrected script and compared it to the old script.

Reviewed pivot table of percentage changes by county for data in Form A-7. The impacts of changes to the windfield model, vulnerability and random year built were reviewed individually and in combination for a number of ZIP Codes and coverage types.

Discussed the decrease in loss costs for mobile home. Reviewed mapping of FHCF exposure data for year built to the model vulnerability eras. Year built was incorrectly applied in the previous submission leading to the large decreases for mobile home. The mobile home loss costs under the previously accepted model version 3.1 are incorrect.

Just prior to the November 15, 2010 submission, an error in treating year built for mobile homes in the previous submission was discovered. Year built was treated as missing leading to an overall weighted average vulnerability function. The error in mapping of the year built in the FHCF exposure data did not have an effect on the use of the model for individual companies. For the current submission, actual year built was incorporated for mobile homes, which is a better reflection of the building stock. This correction would have led to an approximate 7% change in mobile home loss costs. Informed modeler that this error falls under item VI.E. of the Report of Activities on page 50 and should have been reported to the Commission Chair as soon as it was discovered.

Discussed the decrease in loss costs for inland counties due to the new methodology for converting marine winds to actual terrain and the updated ZIP Code centroid locations.

Discussed the percentage changes in loss costs for frame owners north, frame renters, and masonry condos.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

A-11 Probable Maximum Loss*

*(*Significant Revision)*

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

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-9. (Trade Secret List item)

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

No apparent change in procedure from previous model version.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed revised Form A-9 commercial residential results compared to the initial November 15, 2010 submission, the corrected March 2, 2011 submission, and the April 22, 2011 submission.

Reviewed revised Form A-9 results after correction of coding errors for corner/middle units and interior/exterior split in the commercial residential model.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

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

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

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

Professional Team Comments:

Distribution fits for rainfall rate and duration were reviewed in the context of the leak model for commercial residential construction. Several issues and questions were raised regarding the underlying data that support these fits.

1. Rainfall rate numbers were presented as arising from 37 tropical cyclones in Jiang et al. (2008). The precise source of the data used needs to be given and described in detail in the revised submission.
2. Duration values (592) were presented as arising from 23 Florida hurricanes across multiple stations. The precise source of the data used needs to be given and described in detail in the revised submission.
3. The rainfall related distributions fit to the data sets in items 1 and 2 and any pre- or post-processing need to be explicitly documented in the revised submission. All data sources used by the leak model must be explicitly described.
4. The subsequent use of the fitted rainfall distributions in simulating rainfall amounts impacting commercial residential structures needs to be described (including the variate generation algorithms) and the assumption of independence needs to be assessed.
5. The vulnerability, meteorology, and statistical teams need to collaborate their efforts to assure that the Florida Public Hurricane Loss Model is sound as a whole with respect to the rainfall leak model.

Further, Standards G-1, G-4, G-5, A-1, A-2, A-5, A-6, A-9, A-10, A-11, S-5, S-6, C-4, and C-5 cannot be verified pending verification of Standards S-1, M-3, and V-1.

Reviewed K-S, Anderson-Darling, and Chi-square goodness-of-fit tests between historical and modeled data results.

Reviewed goodness-of-fit tests for Holland B parameter, Rmax, and pressure decay term.

Form S-1 was reviewed for consistency with Form M-1.

Reviewed assessment of uncertainty in loss costs and the range of coefficient of variation across counties.

Additional Verification Review Comments

Previously presented rainfall model was replaced.

Reviewed revised Form S-2 commercial residential results compared to the initial November 15, 2010 submission, the corrected March 2, 2011 submission, and the April 22, 2011 submission.

Reviewed revised Form S-2 results after correction of coding errors for corner/middle units and interior/exterior split in the commercial residential model.

S-2 Sensitivity Analysis for Model Output*

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

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

Audit

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

2. Form S-6 will be reviewed.

Pre-Visit Letter

29. Form S-6, pages 338-340: Be prepared to explain the strong drop in loss costs after landfall.

Verified: YES

Professional Team Comments:

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

Reviewed contour plots of mean loss cost for category 1, 3, and 5 storms with revised contour intervals. Discussed the process for computing the standardized regression coefficients. Reviewed plots of the standardized regression coefficients by hurricane category.

S-3 Uncertainty Analysis for Model Output*

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

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

Audit

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

2. Form S-6 will be reviewed.

Verified: YES

Professional Team Comments:

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

Discussed the modeler's plans for the uncertainty analyses for directing future work and the contribution to the uncertainty by far field pressure and central pressure.

S-4 County Level Aggregation

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed scatter plots of percentage of the loss cost estimate versus number of simulation years for Jefferson County and Nassau County and relevant calculations for Madison County.

Discussed no need to adjust the simulation sampling plan. Verified that 55,000 years of simulation are used for final results.

S-5 Replication of Known Hurricane Losses*

*(*Significant Revision)*

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

Audit

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

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

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

4. Form S-4 will be reviewed.

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Reviewed paired t-test analysis between actual and modeled losses and other assessments of the agreement.

Reviewed commercial residential validation comparison in Form S-4. Reviewed the underlying data, the process for converting the year built categories, and the process for generating the modeled losses.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed revised Form S-4 commercial residential results compared to the initial November 15, 2010 submission, the corrected March 2, 2011 submission, and the April 22, 2011 submission.

Reviewed revised Form S-4 results after correction of coding errors for corner/middle units and interior/exterior split in the commercial residential model.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

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

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Reviewed the confidence intervals for personal residential and commercial residential. Verified no significant difference between the historical and the modeled losses.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed revised Form S-5 commercial residential results compared to the initial November 15, 2010 submission, the corrected March 2, 2011 submission, and the April 22, 2011 submission.

Reviewed revised Form S-5 results after correction of coding errors for corner/middle units and interior/exterior split in the commercial residential model.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

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

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

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

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

Audit

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

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

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

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

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

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

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

Information to be presented to the Professional Team:

- C-1.A, page 343 – All the documents are easily available for inspection, and electronic copies are also available online.
- C-1.C, page 343 – These tables are maintained and documented and will be available for review.

Pre-Visit Letter

30. C-1.C, page 343: Be prepared to relate the table of contents with the response to Standard G-1, Disclosure 5 by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Discussed a comprehensive approach to improving the development and verification of the model, and its corresponding implementation, using the following:

- Introduction of pair programming
- Enhancement of inter-specialization communication using internet communication technologies such as video conferencing
- Improvement in the organization of the model by having more face-to-face technical meetings with a greater participation of members from all specialization teams
- Assignment of personnel for the responsibility of coordinating technical tasks across different teams
- Movement of time deadlines for submission of model components to an earlier date in order to ensure a more thorough integration and verification of the model
- Improvement in the data management process by requiring all teams to store more data in a Subversion repository and implementation of an automatic notification mechanism

Reviewed the document “Corrective measures for mitigation errors in FPHLM.”

Reviewed the primary document binder containing detailed information on all components of the model.

Verified that documentation is created separately from and maintained consistently with the source code.

Reviewed the table containing all major and minor changes in the model from the previously accepted model Version 3.1 to Version 4.0.

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

Reviewed the primary document binder which was updated to reflect the changes since the previous submission.

Reviewed the table of changes since the previously accepted submission (Version 3.1). This table included the following changes since the previous submission (Version 4.0) and the current submission (Version 4.1):

1) Modification to the rain estimation in the commercial-residential component,
2) Incorporation of the time related expenses in the insurance loss module,
3) Corrected treatment of corner/middle units in the commercial residential model, and
4) Corrected treatment differentiating between interior and exterior units in the commercial residential model.

C-2 Requirements*

*(*Significant Revision)*

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

Audit

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

Pre-Visit Letter

31. C-2, page 344: Be prepared to provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed new requirements documentation reflecting each model change identified in the modeler's response to Standard G-1, Disclosure 5.

Reviewed requirements documentation for commercial residential.

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

Reviewed the requirements documentation corresponding to the changes in rain estimate and time related expenses.

Reviewed the requirements documentation corresponding to the corrected treatments of corner/middle units and interior/exterior units in the commercial residential model.

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.

Information to be presented to the Professional Team:

- C-3, page 345 – These documents will be made available to the professional team during the site visit.

Verified: YES

Professional Team Comments:

Reviewed the flow chart specifying the improved software development and verification process.

Reviewed a revised flow chart specifying the generation of the pdfs used for the stochastic storm tracks.

Reviewed the flow chart specifying the method used to calculate mid-high rise damage based on risk.

Reviewed the flow chart specifying the enhanced control versioning system.

Reviewed a flowchart for the insurance loss model, including the non-parametric approach to generating expected loss costs for a given exposure.

Reviewed a class diagram for the revised insurance loss model.

Reviewed a revised flow chart of the logic for the insured loss based on building type and year built.

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

Reviewed the flowcharts associated with a breach in the building envelope due to rainfall. The flowchart component for calculating average water ingress per story in the mid/high rise module was found to be incorrect, resulting in an error when the flowchart logic was translated into code. This error was corrected in the flowcharts and code during the audit.

Reviewed the flowcharts for the openings breach area based on building interior vs. exterior calculations. The flowchart calculations were found to be incorrect since they did not differentiate between open vs. closed buildings. This resulted in an error when the flowchart logic was translated into code. This error was corrected in the flowcharts and code during the audit.

C-4 Implementation

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

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

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

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

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

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

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

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

Audit

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

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

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

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

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

b. date created,
c. dates modified and by whom,
d. purpose or function of the component, and
e. input and output parameter definitions.

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

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

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

Trade Secret Disclosure Item:

- The source code for the loss model will be available for review by the Professional Team. (page 4)
- C-4.D, page 346 – The table is available for review by the professional team.

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Reviewed the risk data spreadsheet used as input for damage and financial loss calculations. Reviewed a revised version of the spreadsheet containing column header information inserted during the audit.

Reviewed code used for the total damage and financial loss for risks, including a combined interior/exterior building vulnerability calculation.

Reviewed the original and revised code used to create Form A-6.

Reviewed the data file where the total number of stochastic storms was corrected since the original submission.

Reviewed the implementation of rules on Page 171 of the original submission, and identified an error within the code. The error was determined not to affect submission forms, such as Form A-6. Reviewed correction of this error during the audit.

Reviewed the code metrics table reflecting the model changes.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed the code implementation for the impinging rain model.

Reviewed the code implementation for the water intrusion as a result of breach. Verified that there was an error in the calculation of average water ingress per story. The translation from the flowchart to implementation of this calculation was correct; however, the underlying flowchart logic was incorrect. The logic in the flowchart and code was corrected during the audit.

Reviewed the code implementation for the handling of open vs. closed buildings for calculating breach areas. Verified that there was an error in this calculation. The translation from the flowchart to implementation of this calculation was correct; however, the underlying flowchart logic was incorrect. The logic in the flowchart and the code was corrected during the audit.

Reviewed the revised table of software components as a result of the two code errors discovered during the audit.

C-5 Verification

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

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

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

5. The response to Disclosure 1 will be reviewed.

Information to be presented to the Professional Team:

- C-5.B.1, page 348 – These verification procedures are properly documented and are available for inspection.
- C-5.1, page 350 – The detailed list of the various testing tools and/or techniques used for different components of the system is provided in the main document and will be available for audit.

Pre-Visit Letter

32. C-5, page 348: Be prepared to provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5.

Verified: ~~NO~~ YES

Professional Team Comments:

This standard cannot be verified pending verification of Standards M-3, V-1, and S-1.

Reviewed testing and verification procedures for the model changes identified in Standard G-1, Disclosure 5.

Verified that two executions of the model with no changes in input data, parameters, code, and seeds of random number generators produce the same loss costs and probable maximum loss levels.

Discussed the new notification mechanism for automatic e-mail communication with team members. The automatic notification process will notify all members of a team and the leaders of all the teams in the model whenever data files have been stored in the subversion repository.

Reviewed verification methods at the unit and aggregate level for the following in the model:

1) Zip code update
2) Wind speed correction
3) Monte Carlo simulation for commercial residential low-rise buildings
4) Revised vulnerability approach
5) Insurance loss model and submission forms
6) CAT Fund database

Reviewed the original flowchart for the processes used for manual and automatic verification. Reviewed modifications to this flowchart made during the audit.

Verified the use of both black-box and white-box testing approaches.

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

Verified after resolution of outstanding issues with Standards M-3, V-1, and S-1.

Reviewed the verification approaches used for the rain estimation and time related expenses.

Reviewed revised Forms provided during the audit as a means for verifying the changes in the model as a result of the flowchart and code errors associated with water intrusion to open/closed buildings.

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.

Information to be presented to the Professional Team:

- C-6.1, page 352 – The detailed information will be made available to the professional team during its site visit.

Pre-Visit Letter

33. C-6.D, page 351: Be prepared to provide the model version history leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed the policy for model revision that has not been changed since last year's submission.

Reviewed a checklist of changes from the previous Version 3.1 to the current Version 4.0 of the model.

Reviewed a change in the source code revision system from Concurrent Version System (CVS) to Apache Subversion.

Additional Verification Review Comments

Reviewed the modeler's policy for model revision as well as the history of revisions since the previously accepted submission.

Discussed with the modeler their thoughts on procedures that could minimize the possibility of additional flowchart and coding errors such as those identified here. The modeler expressed confidence in their current procedures.

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:

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

Verified that there were no security breaches since the previous submission.

Verified the modeler's use of enduring non-disclosure agreements to assist in code and data security and copyright enforcement.

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

Verified no change in security policies since the previous submission.