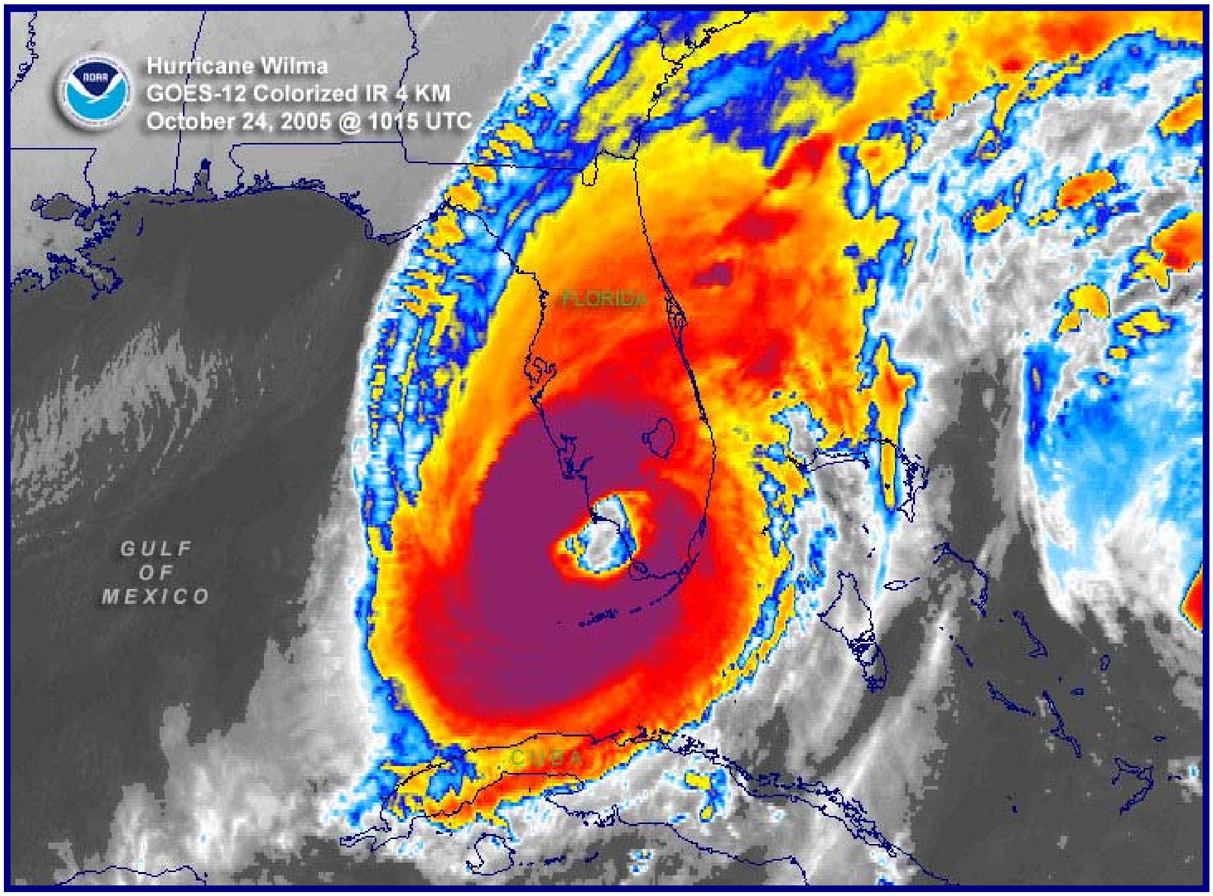
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2006 Standards

Florida Public Hurricane Loss Model

On-Site Review
March 26 – 28, 2007

Additional Verification Review
May 1 – 2, 2007

Second Additional Verification Review
June 18 – 19, 2007

On March 26-28, 2007, the Professional Team visited on-site at Florida International University in Miami, Florida. The following individuals participated in the review.

FIU

Bachir Annane, Senior Research Associate III, CIMAS/HRD
Mahadev G. Bhat, Associate Professor, Environmental Studies Department, Florida International University
Kasturi Chatterjee, Research Assistant, Florida International University
Min Chen, Graduate Student, Florida International University
Shu-Ching Chen, Ph.D., Associate Professor, School of Computing and Information Science, Florida International University
Steve Cocke, Ph.D., Associate Scholar/Scientist, Department of Meteorology and COAPS, Florida State University
Gail Flannery, Actuary, AMI Risk Consultants, Inc.
Fausto Fleites, Student Programmer
Kurt Gurley, Ph.D., Associate Professor, Department of Civil and Coastal Engineering, University of Florida
Shahid Hamid, Ph.D., CFA, Professor of Finance, Florida International University
B.M. Golam Kibria, Ph.D., Associate Professor, Department of Statistics, Florida International University
Jean Paul Pinelli, Ph.D., Associate Professor, Civil Engineering, Florida Tech
Mark Powell, Ph.D., Atmospheric Scientist, NOAA Hurricane Research Division, AOML
Khalid Saleem, Software Engineer Research, Florida International University
Na Zhao, Graduate Research Assistant, Florida International University

Professional Team and SBA Staff

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

The review began with introductions and an outline of the audit process. FIU provided a general overview of the model with a focus on clarifying information provided in the submission through discussions in response to questions in the Professional Team pre-visit letter.

In the course of the audit, it was determined that FIU would revise the model with respect to the radius of maximum winds model and the demand surge model. Consequently, the Output Ranges will need to be newly generated that incorporate the model changes. These model changes impact all Standards and Forms that relate to the stochastic storm set. Vulnerability and Computer Standards were verified to the extent that they do not directly include these model changes. Selected

Standards were verified subject to the condition that revised pages to the final submission will be completed at the additional verification review.

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Additional Verification Review – May 1 – 2, 2007

FIU submitted corrections to the original February 28, 2007 model submission under the 2006 Standards on April 26, 2007. A subset of the Professional Team completed the additional verification review on May 1 & 2, 2007.

The following participated in the additional verification review.

FIU

Bachir Annane, Senior Research Associate III, CIMAS/HRD
Mahadev G. Bhat, Associate Professor, Environmental Studies Department, Florida International University
Kasturi Chatterjee, Research Assistant, Florida International University
Min Chen, Graduate Student, Florida International University
Shu-Ching Chen, Ph.D., Associate Professor, School of Computing and Information Science, Florida International University
Steve Cocke, Ph.D., Associate Scholar/Scientist, Department of Meteorology and COAPS, Florida State University
Gail Flannery, Actuary, AMI Risk Consultants, Inc.
Fausto Fleites, Student Programmer
Shahid Hamid, Ph.D., CFA, Professor of Finance, Florida International University
Aguedo M. Ingco, FCAS, MAAA, ARM, CPCU, Actuary, AMI Risk Consultants, Inc.
B.M. Golam Kibria, Ph.D., Associate Professor, Department of Statistics, Florida International University
Jean Paul Pinelli, Ph.D., Associate Professor, Civil Engineering, Florida Tech
Mark Powell, Ph.D., Atmospheric Scientist, NOAA Hurricane Research Division, AOML
Khalid Saleem, Software Engineer Research, Florida International University
Na Zhao, Graduate Research Assistant, Florida International University

Professional Team

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

The review began with an overview of the additional verification review process as provided in the *Report of Activities* and a recap of the outstanding issues and previous findings from the initial on-site review on March 26-28, 2007. The Professional Team indicated it would be focusing upon the revisions submitted on April 26, 2007.

FIU informed the Professional Team of a revision made to the wind field model that was not identified during the initial on-site review nor reflected in the revised pages sent April 26, 2007. This revision caused a slight increase in the peak winds and a decrease in the peripheral winds resulting in a substantial decrease in the loss costs from model version 2.0.

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

1. Page 10, G-1.2, include map of the threat area matched to the model domain of 100W to 70W, 15 N to 40N
2. Page 12, G-1.2, include adjustment to Rmax to reduce the bias
3. Page 16, G-1.2, include sensitivity studies completed on Weibull parameters chosen and correct the variance
4. Page 17, G-1.2, clarify the first sentence under Contents Damage
5. Page 19, G-1.2, label Table 3 clearly
6. Page 19, G-1.2, better define fragility curve
7. Page 21, G-1.2, correct entry under 1994-present in Table 4
8. Page 26, G-1.4, include Landsea 2004 reference
9. Page 55, M-1.2, clarify references provided are a comprehensive list of publications relevant to the hurricanes in the Base Hurricane Storm Set, but not the basis for the modifications to the Base Hurricane Storm Set
10. Page 70, M-2, revise first paragraph as not in peer reviewed literature ***Change not made***
11. Page 70, M-2.1, clarify pressure decay over land
12. Page 71, M-2.2, include adjustment to Rmax to reduce the bias
13. Page 71, M-2.3, reflect reduction factor of 0.775 used in the code
14. Page 71, M-2.3, correct mean boundary layer to 450m
15. Page 72, M-2.5, include information on derivation and use of form factors that contribute to storm asymmetry
16. Page 73, M-2.9, correct mean boundary layer to 450m
17. Page 76, M-3.1, include information on scenario events not run, only existing historical track fields from the Base Hurricane Storm Set are input into the model
18. Page 83, Form M-1, clarify the statement, “we would expect to find larger numbers of weak (Cat 1-2) hurricanes than major (Cat 3-5) hurricanes.”
19. Page 50, M-5.3, include information on sectors being geographically fixed and not related to storm motion direction
20. Page 90, M-5.5, clarify the basis for Figures 15 & 16
21. Page 95, Form M-2, correct captions for Figures
22. Page 109, V-1.D, correct the number of regions the model uses in Florida
23. Page 111, V-1.1, clarify that sample external pressure coefficients is not the only generation step
24. Page 114, V-1.2, correct header for last column in Tables 9, 10, & 11
25. Page 122, V-2.A & B, expand response
26. Page 131, A-2.2, provide how ALE only claims due to storm surge damage to infrastructure with no insured damage to the property is incorporated
27. Page 134, A-4.1, clarify that the change over time in construction cost is considered in demand surge ***See Additional Verification Review comments under A-4***
28. Page 140, A-5.2, define acronyms in Table 14
29. Page 155, A-8.1, correct x-axis label and provide explanation of legend

30. Page 158, A-10.2, include changes from version 1.5 to version 2.0

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Second Additional Verification Review – June 18 – 19, 2007

At the May 8, 2007 meeting of the Florida Commission on Hurricane Loss Projection Methodology, FIU requested a postponement of the presentation to the Commission stating they were close, but since this was their first submission, they had underestimated the time, effort, and resources required to go through the submission process. The Commission voted to allow the Florida Public Hurricane Model additional time, until June 12, 2007, to submit corrections and revisions to version 2.5 and then for the Professional Team to complete an additional verification review of the revised submission.

FIU submitted corrections to the April 26, 2007 revised model submission on June 12, 2007. The Professional Team completed the additional verification review on June 18 & 19, 2007 in Tallahassee, Florida.

The following participated in the second additional verification review.

FIU

Bachir Annane, Senior Research Associate III, CIMAS/HRD
Min Chen, Graduate Student, Florida International University
Shu-Ching Chen, Ph.D., Associate Professor, School of Computing and Information Science, Florida International University
Steve Cocke, Ph.D., Associate Scholar/Scientist, Department of Meteorology and COAPS, Florida State University
Gail Flannery, Actuary, AMI Risk Consultants, Inc.
Fausto Fleites, Student Programmer
Shahid Hamid, Ph.D., CFA, Professor of Finance, Florida International University
Aguedo M. Ingco, FCAS, MAAA, ARM, CPCU, Actuary, AMI Risk Consultants, Inc.
B.M. Golam Kibria, Ph.D., Associate Professor, Department of Statistics, Florida International University
Jean Paul Pinelli, Ph.D., Associate Professor, Civil Engineering, Florida Tech
Mark Powell, Ph.D., Atmospheric Scientist, NOAA Hurricane Research Division, AOML
Na Zhao, Graduate Research Assistant, Florida International University

Professional Team and SBA Staff

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

The review began with an overview of the additional verification review process and a recap of the outstanding issues and previous findings from the first additional verification on-site review on May 1 & 2, 2007. The Professional Team indicated it would be focusing upon the revisions submitted on and subsequent to June 12, 2007 classified as version 2.6.

In summary, the Professional Team has verified all of the Standards for the Florida Public Hurricane Loss Model version 2.6. This finding was accomplished following two additional verification reviews, each of which addressed extensive model changes as reflected in versions 2.5 and the current version 2.6. The current model represents considerable improvement from model version 2.0. Major improvements include:

- Meteorological changes including aspects of storm genesis, roughness, decay model, and roughness data base
- Vulnerability changes related to building stock and adjustments for appurtenant structures
- New demand surge model, including impacts from large storms striking neighboring states
- Clarification of model descriptions given in the submission
- Elimination of errors in output ranges (Form A-6)
- Elimination of illogical relationships to risk (for example, Okeechobee versus Monroe Counties for various construction types).

Report on Deficiencies

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

1. Standard G-1, Disclosure 2 (page 12)
   Modeler references Powell et al. (2005) that is in press.

2. Standard G-1, Disclosure 4 (pages 26-38)
   - Modeler references Powell, M.D., and T.A. Reinhold, 2007, that is unpublished.
   - References cited under Standard S-1, Disclosure 1 (page 229) are not included.

3. Standard G-2, Disclosure 1.E (page 41)
   Uses are not described, response is unclear.

4. Standard G-2, Disclosure 2.C (page 43)
   Related personnel are not provided with the boxes in Figure 4.

5. Standard G-2, Disclosure 3.B (page 44)
   Statement is non-responsive to the inquiry.

6. Standard G-2, Disclosure 3.C (page 44)
   Response not provided.

7. Standard M-5, Disclosure 7 (page 93)
   Statement is non-responsive to the inquiry.

8. Form V-1.B (pages 123-124)
   Modeler did not confirm that the structures used in completing the form are identical to those in the table provided.

9. Standard A-4, Disclosure 2 (pages 137-138)
   Citations provided are university or government bulletins or reports and not published papers.

10. Standard A-6, Disclosure 2 (page 149)
    Figure 32 is damage ratios versus wind speed without any apparent claims data.

11. Form A-3 (pages 163-164)
    Printed submission and pdf submission file differ from excel and pdf file of Form A-3.
12. Form A-4 (pages 165-175)
    Printed submission and pdf submission file differ from excel and pdf file of Form A-4.

13. Standard S-2, Disclosure 1 (page 248) and Standard S-3, Disclosure 1 (page 251)
    Quantile 1 is not defined.

14. Standard S-4 (page 254)
    Response not provided.

15. Standard S-5 (page 255)
    Response not provided.

16. Form S-5 (page 269)
    Pdf format of required output files not provided.

17. Pdf file of submission differs from the printed submission; example: pdf file is missing Forms G-1 through G-6.

Pre-Visit Letter

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

1. Front Cover, units are m/s.
2. Page 7, Figure 30, extra space between AL and E.
3. Page 10, G-1.1, delete comma after February before 27.
4. Page 10, G-1.2, second line in response, “etc” needs period.
5. Page 33, first two paragraphs are repeated from bottom of page 32.
6. Pages 35-36, “Referred” should be refereed.
7. Page 40, eighth line, “copy right” should be copyright.
8. Page 43, missing “B.” with disclosure wording.
9. Page 44, insert comma after vulnerability; “statistic” should be statistical.
10. Form G-2, delete footer.
11. Page 45, 7. refers to Form G-2 rather than Form G-4.
12. Pages 74-75, Figures 5&6, units are m/s.
13. Page 76, last sentence, delete “Both”.
14. Page 89, bold M-5 title.
15. Page 116, title for Table 11 should be moved to top of page 117 with the table.
16. Page 124, “Damate” should be damage.
17. Page 132, “estimate” under A & B should be estimates.
18. Page 147, Figure 30 title, extra space between AL and E.
19. Page 158, second paragraph under Disclosure 1, “case” should be cases.
20. Page 151, respond to each Standard section separately.
21. Page 228, respond to each Standard section separately.
22. Page 231, last line, delete second “all”.
23. Pages 233-238, Figures 40-45, units are m/s.
24. Page 241, Figure 46, units are m/s.
25. Page 247, paragraph under Figure 48, ks should be capitalized throughout.
26. Pages 251-253, correct Disclosure numbering.
27. Page 264, “FormS5Input04.xls” should be “FormS5Input06.xls”.
28. Page 286, respond to each Standard section separately.
29. Page 289, respond to each Standard section separately.
30. Page 291, respond to each Standard section separately.
31. Page 294, respond to each Standard section separately.

Provide for the Professional Team's review, all insurance company claims data referenced in your submission or used in the development of the model. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) referenced in your submission or used in the development of the model. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

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

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

The Professional Team reviewed additional editorial corrections noted during the course of the audit on June 18 & 19, 2007. Corrections will be provided to the Commission at the June 21-22, 2007 meetings.

GENERAL STANDARDS – Mark Johnson, Leader

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

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

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

Audit

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

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

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

Pre-Visit Letter

1. G-1, Disclosure 2, page 10 – Referring to paragraph, "The model consists…," describe the sub-components and their relationship to the three major components in more detail. Integrate this discussion of subcomponents with Figure 2 on page 25 and lead the Professional Team through the corresponding computer code.

2. G-1, Disclosure 2, page 10 – Referring to paragraph, "To focus on storms capable…," describe the threat area as it is depicted in the code. Is it a circular region centered at 26°N, 82°W as suggested or is it a rectangular array as suggested with the later comment on 0.5° latitude/longitude boxes?

3. G-1, Disclosure 2, page 11 – Referring to paragraph, "The threat area is divided…," how is the threat area divided? Clarify how the historical storms feed into the creation of stochastic storms. Describe fully the PDFs, how they were constructed from the historical data and how they are implemented in the stochastic storms to be generated. Describe the "stochastic approach to model the storm genesis location, track, and intensity evolution".

4. G-1, Disclosure 2, page 11 – Referring to paragraph, "We derive discrete…," it appears that the initial and subsequent motion and intensity of the storm are driven by *discrete* PDFs. Describe this process in much more detail.

5. G-1, Disclosure 2, page 11 – Referring to paragraph, "The intensity parameter…," explain how the simulated storm intensities are constrained with respect to sea surface and upper troposphere temperatures.

6. G-1, Disclosure 2, page 11 – Referring to paragraph, "Specification of the central pressure…," verify that the computer code implements the exponential decay function developed by Vickery (2005).

7. G-1, Disclosure 2, page 12 – Provide a detailed presentation of the wind field. It appears that the papers referenced on this page are essential to follow the development (especially, Vickery et al. (1995, 2000), Willoughby and Rahn (2004), Powell (2003), Vickery and Skerlj (2005), Schmidt and Oke (1990), Axe (2004) and Powell et al. (2005)). Demonstrate how the relevant material from these papers has been integrated into the Florida Hurricane Loss Model.

8. G-1, Disclosure 2, page 13 – Referring to paragraph, "The vulnerability model…," describe the Florida building stock. What is meant by "for each building type statistically significant in the Florida building stock"?

9. G-1, Disclosure 2, page 13 – Discuss basis for combining Site Built and manufactured Homes together. Show and review in depth the referenced "statistical exposure study". Define strong/medium/weak models and show basis for percentage determinations for the different regions of the state. Discuss basis for four categories of manufactured home.

10. G-1, Disclosure 2, page 13 – Referring to paragraph, "A statistical exposure study…," to what extent does the description of specific homes given here correspond to the actual building stock in Florida? How does the damage from the simulations relate to what is observed in actual events?

11. G-1, Disclosure 2, page 14 – Describe the underlying probability distributions used in the component-based Monte Carlo Simulation.

12. G-1, Disclosure 2, page 15 – Referring to paragraph, "A very simple and explicit….," provide the Florida building code requirements and amount of adjustment to loss cost. Describe the model implementation.

13. G-1, Disclosure 2, page 16 – Referring to paragraph, "For each wind speed…," provide the field observations and the material supporting the interior damage equations.

14. G-1, Disclosure 2, page 16 – Referring to paragraph, "To account for the uncertainties…," provide further justification of the parameter choices. The final sentence needs to be addressed.

15. G-1, Disclosure 2, page 17 – Referring to paragraph, "Contents includes just…," provide the Weibull distribution parameters implemented. The Professional Team will examine the claims data and how it relates to the Weibull distributions based on engineering judgment.

16. G-1, Disclosure 2, page 17 – Describe the process of producing contents damage in more detail.

17. G-1, Disclosure 2, page 17 – Referring to paragraph, "For the ALE predictions….," justify the ALE model as it relates to claims data.

18. G-1, Disclosure 2, page 17 – Referring to paragraph, "The equation and methods used….," describe the process, including engineering judgment, used to establish the Rf factor at 0.75.

19. G-1, Disclosure 2, page 18 – Referring to paragraph, "To model appurtenant….," justify the exponential distribution (a continuous distribution) in light of a concentration of mass at zero.

20. G-1, Disclosure 2, page 18 – What factors are considered to determine the distribution of appurtenant structure types and to what does "three types must be assumed" refer?

21. G-1, Disclosure 2, page 18 – Referring to paragraph, "For each Monte Carlo model…," how do the "168 matrices" relate to structural type, region, sub-region and roof cover type?

22. G-1, Disclosure 2, page 19 – Describe Table 3 in more detail.

23. G-1, Disclosure 2, page 19 – Referring to paragraph, "Two important plots derived…," provide a more detailed description on the two important plots. Describe the fragility curve and its effects on the vulnerability curves, positively and negatively.

24. G-1, Disclosure 2, page 20 – Referring to paragraph, "So from the insurance files….," discuss the use and significance of "weight factors".

25. G-1, Disclosure 2, pages 20-21 – Referring to paragraph, "This issue of code enforcement…," provide examples of "consulting with building code development experts" in regards to the code and its enforcement.

26. G-1, Disclosure 2, page 21 – Referring to paragraph, "However, the year-built…," what distributions are used?

27. G-1, Disclosure 2, page 21 – Referring to paragraph, "Although the engineering team…," how does the 1.5 million homes data relate to overall Florida structures?

28. G-1, Disclosure 2, page 23 – Under "Computer System Architecture," discuss the statement, "It aims to solve a number of recurring design and development problems…" in detail.

Verified: ~~**Contingent on page corrections**~~ **YES**

Professional Team Comments:

The following revisions to the response to G-1.2 will be provided:

- Page 10 – map of the threat area matched to the model domain of 100W to 70W, 15N to 40N
- Page 16 – sensitivity studies completed on Weibull parameters chosen and to correct the variance
- Page 17 – clarification on first sentence under Contents Damage
- Page 19 – Table 3 labeled clearly
- Page 19 – better define fragility curve
- Page 21 – correct entry under 1994-present in Table 4

Reviewed the "threat area" as defined in the model domain and the division into regions.

Reviewed the derivation of discrete probability distribution functions based on historical data for storm motion and intensity. Reviewed equations for storm motion, change in storm motion, and storm intensity. Reviewed probability distribution functions written in terms of a matrix defined in ½ degree bins. Reviewed sampling of distributions for storm location and the use of probability distribution functions to determine the initial motion of the storm.

Reviewed graphical representation on the probability of change in direction for 8 direction intervals. Reviewed plot of a storm genesis probability distribution function for a two week interval based on the threat area.

Reviewed the model wind field, its development, and how relevant material from the cited papers was integrated in the model.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised responses under G-1.2 providing:

- Map of the threat area matched to the model domain of 100W to 70W, 15N to 40N
- Sensitivity studies completed on Weibull parameters chosen and correction of the variance
- Clarification on the original statement under Contents Damage, "Contents includes just about anything in the home (including the garage and the outbuildings) that is not attached to the structure itself."
- Table 3 labeled clearly
- A better definition for fragility curve
- Correction for entry under 1994-present in Table 4.

Reviewed new descriptive material on the Rmax adjustment for bias.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the material submitted on and subsequent to June 12, 2007. Requested and reviewed additional overview material documenting the changes to the roughness calculations and their implementation in the surface windfield model.

G-2 Qualifications of Modeler Personnel and Consultants

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

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

Audit

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

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

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

Pre-Visit Letter

29. G-2, Disclosure 2.A, page 42 – Provide resumes for the employees listed in Table 5.

30. G-2, Disclosure 2.C, page 43 – Describe how the physical time and space constraints (indicated by the apparent geographic dispersion of modeler personnel in Table 5) are managed effectively via the line and block arrows in Figure 4.

31. G-2, Disclosure 3.A, page 44 – Discuss independence of peer reviews.

Verified: ~~Contingent upon reviewing outstanding resumes~~ **YES**

Professional Team Comments:

Remaining resumes to review:

Dr. Gary Barnes (Meteorology)
Dr. Duong Ngyue (Actuarial)

Reviewed the following resumes:

- Shahid S. Hamid, Ph.D., CFA, Professor of Finance, Florida International University; Director of the Laboratory for Insurance, Financial and Economic Research, International Hurricane Research Center; Ph.D. in Economics, University of Maryland
- Mei-Ling Shyu, Ph.D., Associate Professor, Department of Electrical and Computer Engineering, University of Miami; Ph.D. in Electrical and Computer Engineering, Purdue University
- Shu-Ching Chen, Ph.D., Associate Professor, School of Computing and Information Science, Florida International University; Director, Distributed Multimedia Information System Laboratory; Associate Director, The Center for Advanced Distributed System Engineering; Ph.D. in Electrical and Computer Engineering, Purdue University
- Mark D. Powell, Ph.D., Atmospheric Scientist, NOAA Hurricane Research Division, AOML; Ph.D. in Meteorology, Florida State University
- Jean-Paul Pinelli, Ph.D., Associate Professor, Civil Engineering Department, Florida Tech; Director, Wind and Hurricane Impact Research Laboratory, Florida Tech; Ph.D. in Structural Engineering, Georgia Institute of Technology, School of Civil Engineering
- Steven Cocke, Ph.D., Associate Scholar/Scientist, Department of Meteorology and COAPS, Florida State University; Ph.D. in Physics, University of Texas
- Kurtis R. Gurley, Ph.D., Associate Professor, Department of Civil and Coastal Engineering, University of Florida; Ph.D. in Civil Engineering, University of Notre Dame
- Golam Kibria, Ph.D., Associate Professor, Department of Statistics, Florida International University; Ph.D. in Statistics, University of Western Ontario
- Mahadev G. Bhat, Ph.D., Associate Professor (Resource Economics) and Graduate Director, Departments of Environmental Studies and Economics, Florida International University; Ph.D. in Agricultural Economics (natural resource economics concentration), University of Tennessee
- T.N. Krishnamurti, Ph.D., Robert O. Lawton Distinguished Professor, Department of Meteorology, Florida State University; Ph.D. in Meteorology, University of Chicago
- Sneh Gulati, Ph.D., Professor, Statistics, Florida International University; Chairperson, Department of Statistics, Florida International University; Ph.D. in Statistics, University of South Carolina
- Min Chen, Ph.D. Candidate in Computer Science, Florida International University; Ph.D. Dissertation Title – “Knowledge Assisted Data Management and Retrieval in Multimedia Database System”; M.S. in Computer Science, Florida International University
- Na Zhao, Ph.D. expected in Computing and Information Sciences, Florida International University; Ph.D. Proposal Title – “Dimuse: An Integrated Framework for Distributed Multimedia System with Database Management and Security Support”; M.S. in Computer Science, Florida International University
- Chelakara S. Subramanian, Ph.D., Professor and Program Chair, Mechanical and Aerospace Engineering, Florida Institute of Technology; Ph.D., University of Newcastle, Australia
- Emil Simiu, Ph.D., P.E., Distinguished Research Professor, Florida International University; Ph.D., Princeton University

- Bachir Annane, Senior Research Associate III, CIMAS/HRD; M.S. in Meteorology, Florida State University
- Neal M. Dorst, Meteorologist, NOAA/AOML/HRD; B.S. in Meteorology, Florida State University
- Nirva Morisseau-Leroy, Senior Software/Oracle Application Developer, University of Miami Cooperative Institute for Marine & Atmospheric Studies; M.S. in Computer Science, Florida International University
- George Andrew Soukup, Ph.D., Physicist, NOAA/AOML/HRD; Ph.D. in Theoretical Physics, University of Chicago
- Guy Ravitz, Research Assistant, University of Miami Department of Electrical and Computer Engineering; M.S. in Electrical and Computer Engineering, University of Miami College of Engineering; Currently enrolled for Ph.D. in Computer Engineering, University of Miami College of Engineering
- Bob Ingco, FCAS, MAAA, CPCU, ARM, President and Consulting Actuary, AMI Risk Consultants, Inc., Miami, Florida; B.S. Mathematics and Physics, United States Naval Academy
- Gail Flannery, FCAS, MAAA, Consulting Actuary, AMI Risk Consultants, Inc., Miami, Florida; M.S. in Statistics, Florida State University
- Khalid Saleem, Ph.D., Software Engineer Research, Distributed Multimedia Information System Laboratory, Department of Computer Science and Engineering/ International Hurricane Research Center, Florida International University; Ph.D. in Computer Science, Florida International University
- Kasturi Chatterjee, Ph.D., Research Assistant, Distributed Multimedia Information System Laboratory, Department of Computer Science and Engineering, Florida International University; Ph.D. in Computer Science, Florida International University
- Fausto C. Fleites, Student Programmer, Florida International University

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed resumes for the following personnel:

- Gary Barnes, Ph.D., Environmental Sciences, University of Virginia; B.A. Meteorology, University of Virginia
- Duong Ngyue, Ph.D., Finance, Florida International University; M.B.A. Finance, Southeastern Louisiana University; B.S. Finance, National Economics University of Vietnam
- Emil Simiu, Ph.D., P.E., Ph.D. Civil & Geological Engineering, Princeton University; M.S. Applied Mechanics, Polytechnic Institute of Brooklyn; Engineering Diploma, Bucharest Institute of Civil Engineering

Reviewed letter from actuaries, Aguedo Ingco and Gail Flannery, describing their independent review of the model.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed revised text and noted several typographical errors and additional revisions needed to address changes in personnel involvement during the recent revisions to the model.

Clarified under G-2.3B that Barnes' review related to a substantially different version of the meteorology model. Text was modified to reflect this.

G-3 Risk Location

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

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

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

Audit

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

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

Pre-Visit Letter

32. G-3.C, page 46 – Provide cited maps showing the zip code boundaries and the associated centroids.

33. G-3.C, page 46 – Describe the process used to validate the ZIP Code data.

Verified: YES

Professional Team Comments:

Reviewed process for ZIP Code verification on data provided by vendor. FIU uses Mapinfo to provide population centroids. Specific example was considered.

*****Additional Verification Review Comments – May 1&2, 2007*****

Examined the centroid location of the large ZIP Code in Okeechobee county.

G-4 Independence of Model Components

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

Audit

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

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

Verified: ~~**Contingent on compliance with other Standards**~~ **YES**

Professional Team Comments:

No bias detected. Specific example using air density demonstrated that the components were handled correctly.

*****Additional Verification Review Comments – May 1&2, 2007*****

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

*****Second Additional Verification Review Comments – June 18&19, 2007*****

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

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

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

Audit

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

Pre-Visit Letter

34. M-1, Disclosure 2, pages 55-69– Identify how each of the publications referenced in this section was used to modify the base hurricane storm set.

Verified: ~~**Contingent on page corrections**~~ **YES**

Professional Team Comments:

Determined that the missing information from HURDAT is supplemented with information from NWS-38 as the basis for the modifications made to the base hurricane storm set. Clarified that the references provided on pages 58-69 are a comprehensive list of publications relevant to the hurricanes in the base set, but were not the basis for the modifications. Response to M-1.2 will be revised to provide this clarification in the submission. Some anomalous cases were described.

Reviewed the basis for the base hurricane storm set. Data set provided by modeler concurred with time frame reported.

Inspected Primary Document Binder for Version 2.0 for the Annual Hurricane Occurrence component of the Storm Forecast Module and contrasted with the same item in documentation for versions 1.5 and 1.0. Both earlier versions had multiple options for the historical database, but the current model did not. Code check to confirm this was done under the computer standards.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised response provided under M-1.2 to clarify that the references provided are a comprehensive list of publications relevant to the hurricanes in the Base Hurricane Storm Set, but are not the basis for the modifications to the Base Hurricane Storm Set.

M-2 Hurricane Characteristics

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

35. M-2, Disclosure 1, page 70 – Referring to paragraph, "The annual occurrence rate…," clarify the statement, "The pressure decay is modeled using an observed data set described in Vickery (2005)."

36. M-2, Disclosure 1, page 71 – Describe the process used in modifying flight level Rmax to surface Rmax. Given the functional form of the Holland wind profile, and the determination of B for flight-level winds, how will this Rmax adjustment affect the overall surface wind structure associated with the storm?

37. M-2, Disclosure 1, page 71 – How do the climate variability modulators (e.g., ENSO) come into the model? No reference was made to these in Standard G-1.

38. M-2, Disclosure 2, page 71 – Are the dependencies described here multivariate linear or some other functional form?

39. M-2, Disclosure 3, page 71 – Describe the surface wind magnitudes arrived at using this approach compared to flight level wind reduction (e.g., Franklin et al. 2003), especially around the Rmax region.

40. M-2, Disclosure 3, page 71 – Given the identification of this 8% sensitivity, why was it not included in the modeling effort?

41. M-2, Disclosure 5, page 72 – Clarify the derivation and use of the form factors to contribute to storm asymmetry. How does this come into Equations (1) and (2)?

42. M-2, Disclosure 6, page 72 – Are the empirical distributions derived directly from HURDAT or are they smoothed or modified in some way?

43. M-2, Disclosure 6, page 72 – What are the criteria used to determine the specific box sizes for storm motion? Describe in detail the storm motion model. Provide details on the validation process.

44. M-2, Disclosure 6, page 72 – How were extrema and variance validated along the mileposts along with the mean values?

45. M-2, Disclosure 6, page 72 – Provide details on the choice of the Poisson distribution per the historical data. The Professional Team will examine the documentation related to the development of the empirical distributions mentioned in this Disclosure.

46. M-2, Disclosure 7, page 73 – How does the model define location at coastline? Clarify your response with the final paragraph of your response to M-2, Disclosure 6.

47. M-2, Disclosure 8, page 73 – Clarify how the random error term was applied and its dependence on the width of the bins.

48. M-2, Disclosure 9, page 73 – Describe how these variations in the surface drag are incorporated into Equations (1) and (2) and traced into the code for the slab boundary layer model.

49. M-2, Disclosure 10, pages 73-75 – Show more examples of modeled and analyzed wind comparisons. Discuss the process for evaluating the model's skill at representing historical storms.

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

Professional Team Comments:

FIU will be investigating how Rmax data is drawn from NWS-38 and will be revising Rmax in the model. Statements, Tables and Forms related to Rmax in the submission will be revised.

Clarified that for pressure decay over land, the model uses the Vickery (2005) Florida peninsula decay equation. Response to M-2.1 will be revised to reflect this information.

Reviewed the surface wind magnitudes based on the 78% reduction factor from mean boundary layer winds as described in Powell et al. (2003). Determined that the value for the reduction factor used in the code is 0.775. Response to M-2.3 will be revised to reflect this information.

Reviewed the derivation and use of the form factors that contribute to storm asymmetry. Response to M-2.5 will be revised to include this information.

A plot of representative stochastic storm tracks will be provided by the modeler.

Reviewed the use of the 450 m mean boundary layer. Responses to M-2.3 and M-2.9 will be revised to reflect the 450 m MBL.

Reviewed the process used, and the reasoning for, modifying flight level Rmax to surface Rmax. Reviewed distribution of flight level Rmax versus surface Rmax based on observations (SFMR data) from 1998-2005 and the choice of modification factor as 0.815. This adjustment produces a larger value for the choice of B than if flight-level value of Rmax were used. This adjustment of B based on the surface Rmax results in a stronger surface wind field than if the regression equation for B did not include this term.

Reviewed the development of climate modulators that are not currently being used. Verified in the computer code that they have been disabled in the user interface.

Reviewed the linear dependence of Holland B on Rmax and Latitude and a quadratic dependence on Delta P. The choice of Holland B governs the distribution of gradient winds.

The slab boundary layer wind depends on the gradient wind which has an inverse linear dependence on air density and Coriolis parameter. Reviewed dependencies among variables in the wind field component described in Powell et al. (2005).

Reviewed reasoning for not modeling uncertainty in the mean boundary layer reduction factor based on uneasiness of implementing an uncertainty in the model.

Inspected treatment of the form factors in the code. Verified this with reference to the documentation.

Reviewed the empirical distributions derived directly from HURDAT and not smoothed or modified in any manner.

Reviewed numerous grid point comparisons of modeled wind against H*Wind.

Reviewed how the pdf is sampled for change in storm direction and its dependence on the current direction of motion and location.

Reviewed the mileposts used for validation and discussed the sensitivity tests conducted to determine the bin sizes. These included 5×1000 year simulations compared against HURDAT by milepost for occurrence, central pressure deficit, forward motion speed and direction. Reviewed comparisons of various storm characteristics. Reviewed some extrema as well.

Confirmed that the model does not use coastline segmentation to determine hurricane frequency.

Reviewed the use of HAZUS roughness values.

Reviewed the code implementation for land cover values.

Clarified the use of the random error term and its dependence on the width of the bins: stochastic model randomly selects a location within the bin chosen to determine the actual value used in the model.

Reviewed how Rmax historical data sources are DeMaria Extended Best Track, H*Wind analyses and NWS-38.

Identified external data sources used in the model: 100 hPa temperatures from the NCEP reanalysis and Reynolds SST (both used for relative intensity), USGS 30-sec resolution topography data for location of coast (landfall location of stochastic storms).

Documentation reviewed:

Multi-Hazard Loss Estimation Methodology Hurricane Model, HAZUS Technical Manual, developed by Department of Homeland Security Emergency Preparedness and Response Directorate, FEMA Mitigation Division, Washington, D.C., 2003.

Shapiro, L., 1984: The Asymmetric Boundary Layer Flow Under a Translating Hurricane. *Journal of the Atmospheric Sciences*, 40, 1984-1998.

Powell, M., E. Uhlhorn, and J. Kepert, 2007: Estimating maximum surface winds from hurricane reconnaissance measurements. Draft article.

Primary Document Binder for implementation of the slab boundary layer and form factors.

Additional Verification Review Comments – May 1&2, 2007

Reviewed revised responses provided under M-2.1 clarifying pressure decay over land, M-2.3 providing the reduction factor of 0.775 used in the code and to correct the mean boundary layer to 450m, M-2.5 providing information on the derivation and use of form factors that contribute to storm asymmetry, and M-2.9 to correct the mean boundary layer to 450m.

Reviewed additional revised responses including:

1) M-2.1, change of model version in response on climate scenarios
2) M-2.1, reference to "transitional storms"
3) M-2.2, revised treatment of Rmax input.

Reviewed plot of representative stochastic storm tracks.

Reviewed plots of the distribution of wind probabilities across wind speed bins comparing versions 1.5, 2.0, and 2.5 for specific ZIP Code examples in Alachua, Dade, and Pinellas counties.

Reviewed plots of over-water wind speed variations from modeled historical storms compared to observations (H*Wind analyses) for Hurricanes Andrew, Charley, Ivan, Jeanne, Dennis, Katrina, and Wilma.

Second Additional Verification Review Comments – June 18&19, 2007

Reviewed methodology change in generation of stochastic storm tracks. For historical landfalling storms in Florida and neighboring states, storm genesis location, intensity, and motion are taken from the HURDAT database track at 36 hours prior to first landfall. For stochastic storms, initial location is based on the set of landfalling storms in Florida: the historical storm locations 36 hours prior to landfall make up the set of seed locations for the stochastic storms. Storm acceleration (i.e. storm movement change) and intensity change for the stochastic set are based on the same spatial grid as before. For all variables (initial location, acceleration, and intensity change), a random variation is added to the historical information at the initial time. At all later times, acceleration and intensity change are sampled directly from PDFs created from the historical records. For storm motion, sampling of the empirical PDFs now occurs every 24 hours, rather than every 6 hours, assuming constant acceleration during the 24 hours.

Reviewed validation goodness of fit tests of the storm track model.

M-3 Landfall Intensity

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

Saffir-Simpson Hurricane Scale:

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

Audit

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

Pre-Visit Letter

50. M-3, Disclosure 1, page 76 – Specify “the damage threshold distance of a Florida zip code” and whether this varies across any ZIP Codes.

51. M-3, Disclosure 1, page 76 – Specify whether there are any constraints on the user defined scenarios input into the model.

52. M-3, Disclosure 3, page 77 – Show the surface wind distribution for this strongest Florida event.

Verified: ~~**Contingent on page corrections**~~ **YES**

Professional Team Comments:

Determined that the model does not permit scenario events to be run, only existing historical track fields from the base set may be input into the model. Response to M-3.1 revised to include this information.

Reviewed the damage threshold distance of 4 x Rmax for large storms and 10 x Rmax for small storms and discussed its relation to the region of damaging winds.

Reviewed color contour plot of the surface wind speed for the strongest Florida event.

Reviewed how by-passing hurricanes are handled in the model. Verified that a storm must be at least hurricane force to be considered. Over land 1-min open terrain surface winds in excess of 30mph are considered.

Reviewed the use of 1-min open terrain surface winds for determining intensity (and hence Saffir Simpson scale) at landfall.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised response under M-3.1 providing information on existing historical track fields from the base set are used as input into the model rather than scenario events.

M-4 Hurricane Probabilities

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

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

Audit

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

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

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

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

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

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

Pre-Visit Letter

53. M-4.A, page 78 – Provide the documentation in support of these modeled probability distributions.

54. M-4, Disclosure 1, page 78 – Describe the process used to support the assumption of a surface pressure profile consistent with flight level pressure/height anomalies.

55. M-4, Disclosure 1, page 78 – Discuss how the assumption of a surface pressure profile consistent with the flight level anomalies can be maintained when the Rmax is varied and V(r) depends on the combination of Rmax and B, along with delP, etc.

56. M-4, Disclosure 2, page 79 – What are the climatic variations referred to here? Could these be accessed by a user in the version of the model being reviewed?

57. Form M-1, page 81 – Provide the analyses leading to the increase in Cat 1 and 3, and decrease in all remaining categories, for historical by-passing storms.

58. Form M-1.C, page 83 – Discuss the statement, "…we would expect to find larger numbers of weak (Cat 1-2) hurricanes than major (Cat 3-5) hurricanes," which is consistent with the historical record, but not with the modeled results.

59. Form M-1.C, page 83 – Provide justification for the statement that HURDAT intensities may occasionally be too high. Does it apply to all regions or only region C?

60. Form M-1.C, page 83 – The argument is made for both miscounting of weaker storms earlier in the record and over-estimation of wind speed intensity throughout the record. How are these two impacts assessed to affect the record overall?

Verified: ~~NO~~ YES

Professional Team Comments:

FIU will be investigating how Rmax data is drawn from NWS-38 and will be revising Rmax in the model. Statements related to Rmax in the submission will be revised.

Reviewed Form M-1. A revised response will be provided to clarify the statement, "we would expect to find larger numbers of weak (Cat 1-2) hurricanes than major (Cat 3-5) hurricanes."

Reviewed the process used for the assumptions made on surface pressure profile consistency with flight level pressure and the development of a Holland B regression equation.

Reviewed the surface pressure profile consistency with surface parameters except for Holland B.

Confirmed that stochastic storm characteristics for adjacent states were given in the milepost exhibits in Standard M-2.

Verified in the computer code that the climatic variation selection section has been disabled in the model graphical user interface.

Reviewed the analyses leading to the increase in Cat 1 and 3 storms and a decrease in the other categories for historical by-passing storms. Reviewed tracks of all by-passing storms.

Reviewed Table A1 from Powell and Aberson, 2001 showing the intensities for regions A, B, and C.

Discussed the difficulty in assessing the impact of the argument that in the later part of HURDAT, wind speed is occasionally overestimated, the overall record is affected by undersampling (1900-1960), and wind speed bias (post 1946).

Discussed that there is no selection process for stochastic storm tracks; all stochastic tracks are used.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed new Rmax formulation including fit of distribution based on data from historical landfall cases and treatment of Rmax to ensure its accurate replication in the windfield used.

Reviewed revised response provided under Form M-1 clarifying the original statement, "We would expect to find larger numbers of weak (Cat 1-2) hurricanes than major (Cat 3-5) hurricanes."

Reviewed additional revised page correcting reference to Form M-5.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed revised Form M-1 results based on the revised 50,000 year simulation.

Reviewed corrected bar graphs of hurricane frequency by region and category.

Reviewed code for determining storm counts recorded in Form M-1.

M-5 Land Friction and Weakening

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

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

Audit

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

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

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

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

5. Form M-2 will be reviewed.

Pre-Visit Letter

61. M-5.A, page 89 – Describe cross-checks done to ensure that the population-weighted ZIP Codes and roughness/land use land cover information are consistent.

62. M-5, Disclosure 1, page 89 – Are the same regional breakdowns used here as in Vickery (2005)?

63. M-5, Disclosure 3, page 90 – How is the 45° sector extending upstream determined? What is the sensitivity to increasing or decreasing the width of this sector?

64. M-5, Disclosure 4, page 90 – Provide the sensitivity analysis for Hurricane Andrew comparing the Landsat and Water Management District land use land cover data sets. Since the Landsat images are from the time of Andrew, discuss additional sensitivity studies with more recent storms (e.g., those in 2004 and 2005). What is the relevance of the final sentence in M-5, Disclosure 4?

65. M-5, Disclosure 4, page 90 – Discuss the impacts of using very dated land use land cover data.

66. M-5, Disclosure 5, pages 91-92 – Are Figures 15 and 16 derived using the "location fixed relative to the storm" method described on page 90? If so, is a constant surface roughness assumed? If these figures are not derived using the "location fixed relative to the storm" method, explain why direct observations were not used for validation (even recognizing lost instruments, etc.), since these are the inputs to H*Wind.

67. Form M-2, Figures 17 & 18, pages 95-96 – Discuss the timeliness of the land use land cover data set in the light of changes of ~30mph over much of the state due to the change from open terrain to “actual” roughness.

68. Form M-2.C, pages 94-98 – Provide the point maximum wind speed values for each plot. Discuss the spatial distribution of surface winds in Figures 17-20.

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

Professional Team Comments:

Verification pending additional review of wind directional maps for 4 counties.

Reviewed the basis for the 45 degree sectors being the Tropical Cyclone Winds at landfall project discussed in Powell et al. (2004), BAMS. Confirmed that sectors are geographically fixed and do not relate to storm motion direction. Response to M-5.3 will be revised to include this information.

Reviewed basis for the plots provided in Figures 15 & 16 being the location containing the maximum winds in the storm, for either a marine or open terrain roughness. Reviewed the methodology used that produces a wind field consistent with the direct observations. Response to M-5.5 will be revised to make clearer the basis for Figures 15 & 16.

Reviewed Form M-2 and the timeliness of the land use land cover data set. Revised Form M-2 will be provided to include the maximum winds plotted on each contour map.

Reviewed the process to validate the consistency between the population-weighted ZIP Codes and the land use/land cover. Reviewed the use of satellite imagery to validate the roughness applied for the ZIP Code centroids.

Confirmed the use of the Vickery 2005 Florida peninsula model throughout all regions.

Confirmed that roughness values used in the model actually derive from the Water Management District land use land cover data sets, the release date of these data and the impact of using this very dated land use land cover data. Response to M-5.4 will be revised to include the land use land cover data set supplied by HAZUS, circa 1994-1995, photographic information rather than Landsat classification, and removal of the final sentence.

Reviewed the change in methodology for converting marine winds to over land winds.

Reviewed the difference in the modeled decay rates for stochastic hurricanes compared to historical hurricanes: observed pressure time series, not the Vickery decay rate model, are used for historical storms.

Reviewed the maximum stochastic wind speeds over actual terrain (Figure 19) relative to the maximum stochastic wind speeds over open terrain (Figure 20) and model sources for this change.

Documentation reviewed:

Axe, L., 2003: Hurricane surface wind model for risk management. Masters Thesis, *Department of Meteorology*, Florida State University, 68pp.

*****Additional Verification Review Comments – May 1&2, 2007*****

The illogical relationship to risk of the loss costs by county in Standard A-6 were attributed by the modeler to result from the over-land winds. The modeler's explanation centered on difficulties in optimally implementing the surface roughness attributes associated with the land use land cover database. The fundamentals of the slab wind model are not in question. The translation of these winds to local surface winds via the friction factors, and the modeler's attribution of this as the cause for the loss costs issues in Standard A-6, are the source of the non-verification of this Standard.

Reviewed revised responses provided under M-5.3 to include information on the sectors being geographically fixed and not related to storm motion direction, M-5.5 clarifying the basis for Figures 15 and 16, and Form M-2.

Reviewed revised captions for Figures 26 and 27 in Form M-2.

Reviewed wind directional maps for a ZIP Code in Okeechobee county and two ZIP Codes in Brevard county.

Reviewed results provided in the revised Form M-2 and the higher wind speeds in inland counties than those in the adjacent coastal counties. Modeler explained that the HAZUS roughness data set used has very low roughness values in these regions, almost equivalent to open terrain.

Discussed that application of land roughness effect on storm winds begins at the first timestep after landfall (i.e., the first timestep after the eye crosses the coast).

Reviewed in detail wind direction frequencies and roughness factors by octant for the ZIP Codes 42 and 87 (Brevard county), 34972 (Okeechobee), 33470 (Palm Beach), 34956 (Martin), and 33001 (Monroe).

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the use of the new roughness values derived from Multi-Resolution Land Cover National Land Classification Database of 2001 that was released on April 25, 2007.

Reviewed the choice of grid used for roughness calculation.

Reviewed the methodology for determining the roughness factor applied to specific ZIP Codes. Reviewed the successive approximation for inland ZIP Codes. Reviewed adjustments to roughness factors for centroids in rural locations.

Reviewed differing treatment for coastal locations.

Reviewed comparisons of the roughness factors between version 2.6 and the previous version 2.5 for several ZIP Codes including 42 and 87 (Brevard county), 34972 (Okeechobee), 33470 (Palm Beach), 34956 (Martin), and 33001 (Monroe).

Reviewed the pressure decay model and the incorporation of the Vickery (2005) models for the Gulf and Atlantic coasts.

Reviewed results provided in revised Form M-2

Reviewed computer code for application of the roughness factors and the subroutine for coastal sectors.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

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

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

Pre-Visit Letter

69. M-6.B, page 99 – Is there any upper wind speed limit to the increase in gustiness associated with increases in surface roughness?

70. Form M-3, page 100 – Explain the variation in the Rmax limits.

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

Professional Team Comments:

Modeler will be investigating the fit of Rmax data used in the model and will be revising Rmax in the model. A revised Form M-3 will be provided.

Reviewed the correlation between the gust factor and surface roughness for all wind speeds. Confirmed that gust factor increases with roughness for all wind speeds, but for a given roughness gust factor decreases with wind speed. There is no asymptote in gust factor – for a given wind speed, it is only limited by limits on the roughness value.

Confirmed that the major factor affecting asymmetry is translation speed and that this is introduced via the form factors.

Reviewed Form M-3 and plots of the variation in Rmax limits.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised Form M-3.

Reviewed the new Rmax model that was substantially revised. The new Rmax model uses the same landfall Rmax data base although a larger independent sample size was used that the modeler felt was more relevant to loss modeling. The modeler tried lognormal and gamma distributions. For Category 1-4 storms, found virtually no dependence of Rmax on intensity at landfall. For Category 5 storms, use a reduced mean taken from the three observed Cat 5 landfalls. Reviewed plots of the two different distributions examined (lognormal versus observed and gamma versus observed). Modeler determined the gamma distribution had a better fit. A lookup table is used to sample from the inverse cumulative gamma distribution function. For Category 5 storms, the Rmax is rescaled so that the model mean is equal to the observed mean. For the transition from low Category 4 to Category 5 storms, linear interpolation is used.

Reviewed test of sampling the inverse cumulative gamma distribution compared against the theoretical distribution of Rmax.

Reviewed scatter plot of the distribution of Rmax on a 10,000 year simulation. Reviewed comparison of the model Rmax to historical landfall Rmax data.

During the validation of the new Rmax model, the Rmax values produced from the wind field solution were found to be 10% greater than the Rmax input in 7 out of the 8 validation cases. The Rmax input was adjusted to produce a solution that removes this outward bias. The impacts of the Rmax adjustment were (1) a slight increase in the peak winds, and (2) a reduction in the radius of 40 mph winds.

Reviewed contour plots of Hurricane Ivan comparing version 2.0 to version 2.5.

Reviewed the revised swath validation (model versus observed) at each ZIP Code. Reviewed example of Hurricane Andrew swath validation.

Reviewed table of change in swath and Rmax errors from version 2.0 to version 2.5.

Reviewed landfall snapshot contour comparisons of modeled versus observed for Hurricanes Andrew, Charley, Frances, Ivan, Jeanne, Rita, Katrina, and Wilma. Reviewed Rmax errors on the distribution fits for modeled versus observed H*Wind gradient wind profiles.

The concerns raised by inspection of Form M-2, Figure 26, relate to wind variations due to heterogeneous roughness variability due to local land use land cover. All else equal, (e.g., Figure 27 for uniform, open terrain), the logical relationships of characteristics are satisfied.

Discussed that the bounds on Rmax given in Form M-3 are derived from the stochastic storm set affecting Florida.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed results provided in revised Form M-3.

Reviewed maps in Form M-2 relating to wind variations due to heterogeneous roughness variability.

VULNERABILITY STANDARDS – Fred Stolaski, Leader

V-1 Derivation of Vulnerability Functions

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

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

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

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

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

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

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

Audit

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

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

3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense should be available. The magnitude of logical

changes among these items for a given wind speed shall be explained and validation materials should be available.

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

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

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

7. Form V-1 will be reviewed.

Pre-Visit Letter

71. V-1.A, page 108 – Provide actual, sample calculations of damage to individual structures.

72. V-1.B, page 108 – Provide examples that show the magnitude of variations due to uncertainty. Actual work is preferred.

73. V-1.C, page 108 – Provide list of "…resources developed exclusively for defining repair costs ….".

74. V-1.D, page 109 – Provide the detailed exposure study. Define "three different regions in Florida".

75. V-1.F, page 110 – Provide examples of vulnerability functions for each of the separate categories.

76. V-1, Disclosure 1, page 111 – Is Step 1 (Sample External Pressure Coefficients) the only variate generation step?

77. V-1, Disclosure 2, page 113 – Provide insurance claims data and discuss process used to verify completeness and accuracy of the data.

78. V-1, Disclosure 3, page 118 – Provide originals or copies of field notes or logs from site damage surveys.

79. V-1, Disclosure 3, page 119 – Provide a summary of the results of towers and pressure sensors placed for hurricanes Frances and Jeanne.

80. V-1, Disclosure 3, page 119 – Referring to paragraph, "Additionally, engineers working…," provide examples of modifications made based on study conducted for the Florida Building Commission.

81. V-1, Disclosure 3, page 120 – Provide examples of aerial imagery used.

82. [This question is under Standard V-2]

83. Form V-1, pages 123-124 – Discuss the magnitude of the Estimated Damage in Part A. Provide explanation of plots provided in Figures 24 & 25.

Verified: ~~**Contingent on page corrections**~~ **YES**

Professional Team Comments:

Response to V-1.D will be revised to reflect the correct number of regions the model uses in Florida.

Response to V-1.1 will be revised to clarify that the sample external pressure coefficients is not the only variate generation step.

Response to V-1.2, Tables 9, 10, and 11 will be revised to correct header for last column.

Reviewed plots provided in Form V-1 for total damage and building damage and the appearance of no difference between the two. Figure 25, building damage is incorrect in the submission and a corrected figure will be provided.

Reviewed the vulnerability and fragility curves. Improved definition of fragility curve provided in Standard G-1, Disclosure 2 will be included in the revised submission.

Reviewed in depth the use of data from nine counties, statewide, to determine the distribution of structure types and characteristics. The initial development of this work was around 2001. It was noted by the Professional Team that since that time, the tax parcel data has been available for every county and has been used in reports available in the public domain in the context of catastrophe modeling.

Reviewed the origination and basis for the boundaries between the four regions for Florida in the model. Reviewed the error in the distribution estimates for the four regions. The initial report of an 8% error in structure type 3 having 39% overall seemed very high given that there were tens of thousands of structures involved. Upon further examination of the engineering reports, it was found that the error was driven by the cluster sampling method used (not a cluster theory), the error limits of which are predicated upon random sampling of clusters within the regional sampling frame of counties. As the counties chosen were those that cooperated (convenience sample), the randomization assumption is not appropriate. Engineering judgment was used to defend the representativeness of the counties used in each region.

Reviewed actual, sample calculations of damage to individual structures.

Reviewed the year built classification for masonry based on insurance portfolios for the four age groups (prior to 1970, 1970-1983, 1984-1993, and 1994-Present) by region.

Reviewed examples of the model differences for various structures and connections.

Reviewed model distribution of structures by age and type.

Reviewed basis for the four categories of manufactured homes.

Reviewed the cost estimating resources used to determine cost of repairs and estimated time for repairs.

Reviewed vulnerability functions for concrete building, concrete contents, concrete ALE, wood building, wood contents, wood ALE, manufactured home structure, manufactured home contents, and manufactured home ALE. Reviewed division of structures into weak, medium, and strong categories.

Reviewed the probability distributions used in the component-based Monte Carlo Simulation. Reviewed the probabilistic variables.

Reviewed examples of consulting with building code enforcement officials as basis for handling building code and its enforcement including Charley Everly, Code Technology Inc., Sarasota, Florida, and Richard Dixon, Executive Chairman of the Florida Building Commission.

Reviewed the implementation of Florida Building Codes in the model. Reviewed examples of applying building thresholds of damage in the model and damage ratios.

Reviewed interior and content damage due to sheathing and gable end damage and the associated vulnerability functions. Validation based on expert opinion as relevant claims data not available.

Reviewed the process for producing contents damage and ALE expenses. ALE and contents use the same Weibull distribution.

Reviewed the equation and methods used to determine ALE for manufactured homes with the use of a factor Rf of 0.75 based on engineering judgment.

Reviewed plots of wind versus appurtenant structure damage ratio and structure damage ratio. Reviewed choice of distribution.

Reviewed the factors considered for determination of the Weibull distribution for appurtenant structures. Reviewed plots of vulnerability curves for appurtenant structures for all regions.

Reviewed basis and composition of the matrices used to develop vulnerability functions related to structure type and region.

Reviewed the insurance claims data used for developing the vulnerability functions and the process used to validate the data. Discussed the problem with the lack of consistency in the data and the potential causes for this inconsistency.

Reviewed weighted vulnerability matrices by type and how the matrices are implemented in the model. Reviewed example of a masonry home.

Reviewed how unknown year built is handled in the model by applying a weighted matrix based on the location (ZIP Code). Reviewed example of a masonry home in the Central Florida region.

Reviewed plots of the mean damage results from the Monte Carlo simulation on damage to the roof cover at various wind speeds. Reviewed plots for masonry building, ALE, and content losses.

Reviewed results of field validation data obtained from wind speed towers and pressure sensors on roofs placed for Hurricanes Frances and Jeanne. Reviewed the process for selecting locations to gather data and the installation of sensors at the locations. Reviewed aerial photos (mix of old and new, hip and gable) used as validation for roof covering and sheathing.

Reviewed copies of original field notes from site damage surveys. Reviewed graphic of 126 surveyed homes after Hurricane Charley.

Reviewed computer code for the minimum wind speed where damage occurs.

Reviewed recalibration of vulnerability curves in version 2.0 from version 1.5 due to additional insurance claims data. Reviewed plots of structure losses comparing the changes made in version 2.0.

Documentation reviewed:

Thesis by Francisco Garcia, Cost Effectiveness of Mitigation Measures in Florida, December, 2006.

Thesis by Joshua Murphree, Florida Public Hurricane Loss Projection Model: Development Calibration and Validation of Vulnerability Matrices, December, 2004.

Thesis by Liang Zhang, Public Hurricane Loss Prediction Model: Exposure and Vulnerability Components, May, 2003.

Post 2004 Hurricane Field Survey – an Evaluation of the Relative Performance of the Standard Building Code and the Florida Building Code. Principal Investigator Kurtis Gurley, Associate Professor, University of Florida, Department of Civil and Coastal Engineering. Project Manager Rick Dixon, Florida Building Commission, Florida Department of Community Affairs. Structures Research Communication No. 53102-2, UF Project No. 00053102, March, 2006.

Post Disaster Investigation Manual for Hurricanes, Institute for Business & Home Safety, Created by the Institute for Business & Home Safety, Last Updated May 5, 2006.

Florida Public Hurricane Loss Projection Model, Engineering Team Final Report submitted to Florida Office of Insurance Regulation by Dr. Shahid Hamid, International Hurricane Research Center, Florida International University, Volume I – Exposure and Vulnerability Components of the Florida Public Hurricane Loss Projection Model, May, 2005.

Florida Public Hurricane Loss Projection Model, Engineering Team Final Report submitted to Florida Office of Insurance Regulation by Dr. Shahid Hamid, International Hurricane Research Center, Florida International University, Volume II – Predicting the Vulnerability of Typical Residential Buildings to Hurricane Damage, March, 2005.

Florida Public Hurricane Loss Projection Model, Engineering Team Final Report submitted to Florida Office of Insurance Regulation by Dr. Shahid Hamid, International Hurricane Research Center, Florida International University, Volume III – Development Calibration and Validation of Vulnerability Matrices of the Florida Public Hurricane Loss Projection Model, May, 2005.

Validation of the Florida Public Hurricane Loss Projection Model by J.-P. Pinelli, C.S. Subramanian, K. Gurley, and S. Hamid.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised responses provided under V-1.D to correct the number of regions the model uses in Florida, V-1.1 to clarify that sample external pressure coefficients is not the only generation step, and V-1.2 to correct the header for the last column in Tables 9, 10 and 11.

No additional issues on vulnerability were identified.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the development of weak, medium, and strong vulnerability matrices based on year built and the new methodology for combining vulnerability functions when year built is unavailable.

Reviewed the change in methodology of matrix development for the Keys to reflect a larger diversity of building stock and increased uncertainty.

Verified there were no changes to the vulnerability functions.

Reviewed the revised computer code for the application of the new building statistics.

Reviewed the computer code for the Keys matrix selection using year built.

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

Verified there are separate vulnerability functions for structural building damage and new vulnerability functions for appurtenant structures.

Discussed differences between the buildings and appurtenant structures such as structural design, construction and inspection process, and strength of construction materials. Reviewed insurance data on actual damage to appurtenant structures which was used to validate the vulnerability function.

V-2 Mitigation Measures*

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

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

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

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

Audit

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

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

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

Pre-Visit Letter

82. V-2, page 122 – Expand on the responses and provide some references and examples.

83. [This question is under Standard V-1]

84. Form V-2, page 125 – Describe Form V-2 in detail.

85. Form V-3, page 126 – Please complete the REFERENCE STRUCTURE row in Form V-3. Provide a copy of Form V-3 with the completed REFERENCE STRUCTURE row when the Professional Team arrives, and also provide the electronic file used to complete Form V-3 on a removable drive medium. (This material will be used during the on-site review and will be returned when the on-site review is complete.)

86. Form V-3, page 127 – Describe each of the curves related to the legend in Figure 26, Vulnerability Curves for Reference Msnry Structure-1 (upper graph).

Verified: ~~**Contingent on page corrections**~~ **YES**

Professional Team Comments:

Responses to Standard V-2, parts A and B will be revised and expanded.

Reviewed results provided in Forms V-2 and V-3 including a new Form V-3 with the REFERENCE STRUCTURE row completed.

Reviewed the following mitigation measures modeled in Form V-2, their implementation and effect on loss cost results: Rated Shingles, Hip Roof, Roof to Wall Connection, Stud to Sill Connection, Roof Sheathing Nails, Shutters, Windows, Gable End Bracing, and Masonry Reinforcing.

Reviewed the vulnerability curve for a mitigated masonry structure.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised expanded responses provided under V-2.A and V-2.B.

No additional issues on vulnerability were identified.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Verified no changes were required for the previously submitted Forms V-2 and V-3.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs

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

Audit

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

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

Pre-Visit Letter

87. A-1, Disclosure 1, page 129 – Describe the process used to determine the "specific threshold distance" referenced in the response.

Verified: YES

Professional Team Comments:

Actuary not available.

Reviewed the threshold distance for by-passing storms to be considered in the model. Reviewed graph showing tracks for all Florida by-passing storms.

Reviewed the following documentation:

Actuarial Model for Estimated Insured Hurricane Losses, Public Hurricane Loss Projection Model, Dr. Shahid Hamid, Professor of Finance, College of Business and Director, Laboratory for insurance Financial & Economic Research, International Hurricane Research Center, Florida International University

*****Additional Verification Review Comments – May 1&2, 2007*****

Discussed with Aguedo Ingco and Gail Flannery their testing of by-passing storms from the stochastic storm set for correct inclusion or exclusion.

A-2 Underwriting Assumptions

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

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

Audit

1. Demonstrate how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify model calculations. For example, the level of damage the insurer considers a loss to be a "total loss." Provide the methods used to delineate among the insurer claim practices in the use of historical claims data to verify model outputs.

Pre-Visit Letter

88. A-2.B, page 130 – Provide the documented procedure cited in the first paragraph under Part B. Provide samples relating to the implementation of the procedure for each insurer providing data to the process. Describe the implementation of the procedure relative to the lack of ALE coded data from one insurer (see note, page 113). Provide samples of correspondences between insurers and FHLM.

89. A-2, Disclosure 2, page 131 – Describe how the model incorporates "ALE only" claims that are due to storm surge damage to the infrastructure with no insured damage to the insured property.

90. A-2, Disclosure 3, page 131 – Provide computer code that indicates the cited option is turned off in the production of the Commission loss costs.

Verified: YES

Professional Team Comments:

Actuary not available.

Reviewed how ALE only claims due to storm surge damage to the infrastructure with no insured damage to the property is incorporated in the model. A revised response to A-2.2 will be provided to include this information.

Discussed claims data received from the Office of Insurance Regulation, the process of "cleaning" the data for validation purposes, and related correspondence with the insurers through the Office of Insurance Regulation.

Discussed the lack of information provided in some of the data, the inability of the modeler to obtain additional information, and the resulting assumptions and adjustments necessary.

Reviewed the Pre-Processing Checklist for processing claims data. Reviewed the procedures for handling errors in the data for ZIP Code, year built, construction type, property value, policy limits, deductible, content, and ALE.

Reviewed summary of claims data from Hurricanes Andrew, Charley, Frances, Irene, Opal, and Erin.

Reviewed loss ratio plots of actual versus modeled for structure, content, and ALE.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised response under A-2.2 providing how ALE-only claims from storm surge damage to the infrastructure with no insured damage to the property are incorporated in the model.

Discussed with Aguedo Ingco and Gail Flannery their review that consisted of analyzing and testing the approach used to deal with duplicate, missing and invalid records in the validation data, review of the data call used to request data from insurance companies, and review of model flow charts, manual calculations of losses for specific policies and sample damage matrices in responding to part B of Standard A-2.

Reviewed the process for estimating ALE losses in the model when ALE is not provided or separated out in the claims data.

Reviewed how the model handles differences in claims practices of insurance companies. The model does not distinguish between companies' claim practices and underwriting assumptions.

Reviewed how unknown construction codes in the claims data are handled in the model development and validation.

Discussed the exclusion of Hurricane Ivan losses from the claims data due to distortion of covered claims data from storm surge damage.

Reviewed the process whereby depreciation is not explicitly considered in the model; that the values of the structures and contents are assumed to equal the policy limits.

Confirmed that loss adjustment expenses are not included in the loss costs.

Reviewed insurance claims data from the 2004 hurricane season losses.

Reviewed process of dealing with anomalies or apparent errors in claims data.

A-3 Loss Cost Projections*

*(*Significant Revision)*

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

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

Audit

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

Verified: YES

Professional Team Comments:

Actuary not available.

Discussed the use of claims data that would not include expenses, etc.

*****Additional Verification Review Comments – May 1&2, 2007*****

Discussed with Aguedo Ingco and Gail Flannery their review of the loss costs to confirm that expenses, risk loads, investment income, premium reserves, taxes, assessments, or profit margin are not included in the loss costs.

A-4 Demand Surge*

*(*New Standard)*

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

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

Audit

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

Pre-Visit Letter

91. A-4, pages 134-138 – Provide a detailed description of the process used in the model to account for demand surge, including any analyses performed to determine that the resulting demand surge adjustments are actuarially reasonable. Have available any data, reports, expert opinions, etc. used in developing this process.

92. A-4, pages 134-138 – Explain how demand surge is incorporated in the model relative to contents and ALE loss costs.

93. A-4, Disclosure 1, pages 134-137 – Explain each step in the development process, including the critical step in Demand Surge development, the territorial selections, and all other steps. Provide all reference material on which this process and its steps are based. Particularly, explain the statement, "We believe that the extrapolation of construction cost indices from six original cities to counties beyond the immediately adjacent counties will be hard to justify."

94. A-4, Disclosure 1, page 135 – Referring to paragraph, "The adjusted R^2 values…," provide the data underlying these fits.

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

Professional Team Comments:

Actuary not available.

Response to A-4.1 will be revised to clarify that the change over time in construction cost is considered in demand surge.

Reviewed the use of the same factors for both structural loss and content and ALE losses in the calculation of demand surge. FIU will revisit this issue.

Reviewed in detail the development process and application of demand surge in the model. Reviewed the calculations for demand surge adjustment factors, the data sources, and the methodology used in gathering data from the six Florida cities and surrounding counties. This issue will be revisited.

Reviewed graph showing the construction cost adjustment factor applied as residential property damage increases.

*****Additional Verification Review Comments – May 1&2, 2007*****

At the first on-site visit, the Professional Team reviewed the demand surge model and recommended an overhaul of this model, noting that the methodology used in gathering data from the six cities and surrounding counties should be re-visited. It was admitted in the February 27, 2007 submission: "We believe that the extrapolation of construction cost indices from six original cities to counties beyond the immediately adjacent counties will be hard to justify." In version 2.5, the demand surge model has been modified to use retail price indices at the county level to extrapolate the six city construction costs to other counties. The Professional Team questioned the validity of using retail price indices that include a substantial weighting of food and beverage components to extrapolate construction costs.

Neither the modeler nor the signatory actuary provided any compelling evidence in support of the version 2.5 demand surge model. Our concerns with the demand surge model include:

- Retail price indices to extrapolate construction costs
- County-specific demand surge factors
- Gross domestic product as used for demand surge
- Treatment of Monroe County for demand surge.

Reviewed revised response provided under A-4.1; however, the change over time in construction cost is still not appropriately considered in demand surge. The Professional Team expressed concerns with only tweaking the demand surge model and using the Florida Retail Prices Index for determining changes in the Construction Cost Indices over time.

Reviewed that the model estimation demand surge methodology remains based on an average of six counties construction cost indices for 2003 to 2006. This average is assumed to be transferable for the remaining 61 counties in Florida.

The methodology recognizes that the construction cost indices reflect respective price changes from the National Base Construction Cost in 1993. An adjustment is made for inflation by deflating the Construction Cost Indices using the National GDP implicit price deflators.

Reviewed OIR loss data from 2004 and the process used to determine ultimate paid losses based on claim adjuster's estimates.

Reviewed the model variables of housing unit growth, population, national construction costs, and hurricane damage. The modeler agreed that removing housing unit growth as a variable may be appropriate.

Reviewed plot of the construction cost adjustment factor for residential property damage for an average Florida county. Reviewed the demand surge adjustment factors for Miami-Dade county.

Reviewed the methodology for applying demand surge to contents losses by using a contents demand surge that is ¼ of the structural cost demand surge.

Reviewed the methodology for applying demand surge to ALE losses using a state-wide factor of 1.0130 that assumes ALE expenditures are based upon 50% housing rental and 50% food and beverage. Discussed problem associated with applying the demand surge methods to specific areas such as Key West.

Reviewed flowchart of the overall approach for applying demand surge to loss costs.

Reviewed computer code for implementation of the demand surge model.

Reviewed the spreadsheet data for the model coefficients used for application of the demand surge adjustment factors for all counties. Reviewed the process for manually copying and pasting the coefficients from the spreadsheet and translating the data to the computer for implementation in the model.

Reviewed and discussed the rationale for demand surge adjustment factors less than 1 that are calculated by the process.

Discussed with Aguedo Ingco his review and validation of the demand surge model. Discussed the issues he raised with the modeler over assumptions made.

Discussed the conversation between the actuaries and the modeler regarding the efficacy of using regions rather than county level data for the demand surge adjustment factors.

Reviewed the rationale behind the assumed maximum per county hurricane loss included in the demand surge model.

Actuaries and modeler unable to offer how the model would handle the difference in the demand surge adjustment factors for a loss exceeding $20 billion in Miami-Dade county relative to large losses in adjacent counties.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Discussed the lack of consideration in the demand surge factor in Florida for large storms that make landfall in neighboring states.

Discussed with Aguedo Ingco his review of the new demand surge model.

Reviewed the development of the revised demand surge factors applied to modeled losses for four different regions – North, Central, South, and Monroe County. Reviewed the judgmentally based parameters for Monroe County that factors in additional cost over those factors for the South Region.

Reviewed Boeckh Construction Index data purchased from Marshall Swift for 52 ZIP Codes and 42 counties for 1992 to 2007 quarterly used in the revised demand surge calculations.

Reviewed development of regional construction cost indices using population weights and the process used to measure demand surge in the revised demand surge calculations.

Reviewed regional construction cost indices by quarter. Reviewed the general form of fit to the regional construction index for historical hurricanes for several regions. Reviewed the weighting applied to the first four quarters after a storm.

Reviewed calculation of weighted average demand surge for 10 historical observations.

Reviewed evidence used to derive the new judgmental demand surge factor for Monroe County.

Reviewed the methods to develop the new demand surge factor for contents demand surge based on the same approach used for structure and using sub indices of the bi-monthly CPI from the Bureau of Labor Statistics. For validation, there was only a single observation in the Miami/Ft. Lauderdale area before and after Katrina/Wilma.

Reviewed the development of the new demand surge factor for ALE. Since there were no observations for ALE, used actual reported losses from validation data set consisting of 3 storms and 11 companies. Next, modeled the relationship between ALE and structural losses. From the model, estimated the percentage change in ALE losses for a given percentage change in structural losses.

Reviewed plots of the demand surge factors for structure, contents, and ALE.

Reviewed the application of a demand surge adjustment factor for Northwest Florida region storms to account for potential bias in the model due to large storms that make landfall in neighboring states. Reviewed counties affected in the Northwest region where the demand surge adjustment factor will be applied.

A-5 User Inputs

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

Audit

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

2. All insurer inputs and assumptions will be reviewed.

Pre-Visit Letter

95. A-5, Disclosure 2, pages 140-144 – Identify and define the following items in Table 14:
    PILM (pages 140-141)
    LMs (page 143)
    LMapp (page 143)
    LMc (page 143)
    Lmale (page 143)

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

Professional Team Comments:

Actuary not available.

Reviewed the Model Output Report and discussed the various acronyms. Response to A-5.2 will be revised to define acronyms used in Table 14.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised response provided under A-5.2 with acronyms in Table 14 defined.

Discussed with Aguedo Ingco and Gail Flannery their review and analysis of the model input form, review of the validation automation program and the Matlab plotting program, and the review of the pre-processing check list.

A-6 Logical Relationship to Risk

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

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

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

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

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

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

G. The relationship of loss costs for individual coverages, (e.g., structures and appurtenant structures, contents, and loss of use/additional living expense) shall be consistent with the coverages provided.

Audit

1. Graphical representations of loss costs by ZIP Code and county will be reviewed.
2. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.
3. Individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, and A-5 will be used to assess coverage relationships.

Pre-Visit Letter

96. A-6, Disclosure 2, page 148 – Explain the comparison provided in Figure 31.

102. Form A-3, page 163 – Provide an explanation of the date and naming system used in Form A-3.

103. Form A-5, pages 176-177 – Describe the process used to produce Form A-5 including computer code or other means used to generate the Form.

104. Form A-5, page 177 – Explain the 0 values.

Verified: ~~NO~~ YES

Professional Team Comments:

Actuary not available.

Forms to be revised in accordance with resubmission.

Reviewed the comparison provided in Figure 31 for appurtenant structures loss ratios.

Reviewed the vulnerability matrix at 3-second gust wind speeds.

Reviewed the probability of damage at the various wind speeds and the combination of individual vulnerability functions to calculate total damage and loss costs.

Reviewed the flowchart and the process used to complete Form A-5.

Reviewed the naming system and the process used to complete Form A-3.

*****Additional Verification Review Comments – May 1&2, 2007*****

The Professional Team noted a number of instances which did not comply with this Standard. In our opening remarks on the revisit, we noted the following concerns relative to the version 2.5 output ranges (all with zero deductible):

Logical relationship to Risk (A-6)

- Okeechobee Wood Frame > Monroe and Miami-Dade Wood Frame
- Glades, Okeechobee, Martin, Palm Beach, Broward, Miami-Dade Masonry > Monroe Wood Frame
- Mobile homes in Monroe < Mobile homes in Miami Dade

The modeler attributed these anomalies to the surface winds resulting from the local friction factors. The modeler indicated that the data base on friction factors is expected to be replaced in the next version of the model. With respect to version 2.5, the Professional Team could not verify this Standard in light of the above noted relationships. Consequently, the related Standard M-5 is also precluded from verification.

Reviewed revised Forms A-1 through A-5.

Discussed with Aguedo Ingco and Gail Flannery their review of the loss costs, testing the loss cost outputs to determine any illogical relation to risk for coverage, construction, territories, deductibles, etc., discussions with the modeler regarding illogical relationships, and their review of the model versus actual graphs.

Reviewed underlying data for points provided in Figure 31, Model versus Actual – APP Loss Ratios. Reviewed a corrected figure that will be provided in the revised final submission.

Discussed the actuaries' process and review of Forms A-1 through A-5.

The Professional Team expressed concern over the stability of model results including substantial changes in loss costs between model version 1.5 and 2.0 followed by substantial changes in loss costs between model version 2.0 and 2.5 relative to subsection A of this Standard.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Revisions in version 2.6, while producing additional and substantial changes in several individual loss costs, resulted in relationships to risk that are consistent with the requirements of this Standard.

A-7 Deductibles and Policy Limits

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

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

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

Audit

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

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

Pre-Visit Letter

97. A-7, page 151 – Provide the computer code relating to the deductible allocation process referenced in the last sentence of the first paragraph.

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

Professional Team Comments:

Actuary not available.

Reviewed the computer code and process for applying deductibles.

*****Additional Verification Review Comments – May 1&2, 2007*****

Discussed with Aguedo Ingco and Gail Flannery their review of the method for handling deductibles and policy limits. This review included testing of the method to reflect deductibles and policy limits, testing of the relationship among modeled deductible loss costs for reasonableness, and testing of the deductible loss cost calculations for application of multiple deductibles.

Confirmed that the hurricane deductible is reduced each time when there is more than one hurricane in a single year and that when the hurricane deductible is exhausted, the all other perils deductible is applied in compliance with Florida Statutes.

A-8 Contents

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

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

Audit

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for contents coverage. To the extent that historical data are used to develop mathematical depictions of contents functions, demonstrate the goodness-of-fit of the data to fitted models. Justify changes from the prior submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Pre-Visit Letter

98. A-8, page 154 – Provide the methods, assumptions and calculations used for producing contents loss costs.

99. A-8, Disclosure 1, page 155 – Explain legend for Figure 33.

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

Professional Team Comments:

Actuary not available.

Reviewed Figure 33 and the response to A-8.1 will be revised to correct the x-axis label and to provide an explanation of the legend.

Reviewed the methodology, calculations, and assumptions used for producing contents loss costs.

*****Additional Verification Review Comments – May 1&2, 2007*****

The Standard could not be verified due to problems associated with demand surge.

Reviewed revised response provided under A-8.1 to correct x-axis label and explanation of legend.

Discussed with Aguedo Ingco and Gail Flannery their review of the method used to calculate loss cost for contents relating to personal residential structures including comparisons of historical actual versus estimated loss cost.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the development of the new contents demand surge factor estimated at 30% of the structural demand surge factor.

A-9 Additional Living Expense (ALE)

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

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

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

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

Audit

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

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

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

Pre-Visit Letter

100. A-9, page 156 – Provide the methods, assumptions and calculations described in the disclosures for producing ALE loss costs.

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

Professional Team Comments:

Actuary not available.

Reviewed in detail the methodology, calculations, and assumptions used for producing ALE loss costs.

*****Additional Verification Review Comments – May 1&2, 2007*****

The Standard could not be verified due to problems associated with demand surge, including specific problems associated with ALE demand surge.

Discussed with Aguedo Ingco and Gail Flannery their review of the method used to calculate loss cost for ALE including comparisons of historical actual versus estimated loss cost.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the development of the new ALE demand surge factor.

A-10 Output Ranges

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

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

1. masonry construction versus frame construction,

2. residential risk exposure versus mobile home risk exposure,

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

4. in general, northern counties versus southern counties.

Audit

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

2. The modeler will be required to justify the following:

    a. Changes from the prior submission of greater than five percent in weighted average loss costs for any county.
    b. Changes from the prior submission of five percent or less in weighted average loss costs for any county.

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

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

Pre-Visit Letter

101. A-10, pages 158-159 – Provide information relative to changes in the output ranges produced by version 2.0 with output ranges previously produced by version 1.5. Provide the information in a form similar to that of Form A-7.

    a. Provide justification for changes from the loss costs produced by version 1.5 that are greater than ten percent in the weighted average loss costs for any county, specifically by county.

    b. Provide justification for changes from the loss costs produced by version 1.5 that are ten percent or less in the weighted average loss costs for any county, specifically by county.

102. [This question is under Standard A-6]
103. [This question is under Standard A-6]
104. [This question is under Standard A-6]

105. Form A-6, pages 179-185 – Explain how for Owner's Frame, the $0 deductible appurtenant structure and $0 deductible ALE for Low are identical for Brevard, Calhoun, Collier, Columbia, De Soto, Franklin, Gilchrist, Hamilton, Hernando, Lafayette, Lake, Madison, St. Lucie, Taylor, Wakulla, and statewide (= Columbia).

106. Form A-6, pages 186-192 – Explain similar anomaly for Owner's Masonry for Brevard, Calhoun, Collier, Columbia, De Soto, Franklin, Gilchrist, Hamilton, (not Hernando), Lafayette, Lake, Madison, St. Lucie, Taylor, Wakulla, and statewide (= Columbia again).

107. Form A-6, pages 193-199 – Explain similar anomaly for Mobile Homes. The counties are fewer with this structure: Columbia, Hamilton, Lafayette, Madison, and states (= Columbia).

108. Form A-6, page 203 – Provide explanation for Renter's Frame in Lafayette county where the weighted average equals the High across all the columns.

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

Professional Team Comments:

Actuary not available.

Reviewed changes in the meteorology and vulnerability components in version 2.0 from version 1.5. Response to A-10.2 will be revised to include these changes in the submission.

Reviewed the affect on loss costs from the changes implemented in version 2.0 from version 1.5. Changes to be provided in a form similar to that of Form A-7 and Form A-8.

Form A-6, Output Ranges to be revised with resubmission.

Reviewed plots of differences in the wind speed as a result of the changes to the meteorology component of the model.

*****Additional Verification Review Comments – May 1&2, 2007*****

The Professional Team noted a number of instances which did not comply with this Standard. In our opening remarks on the revisit, we noted the following concerns relative to the version 2.5 output ranges (all with zero deductible):

Logical relationship to Risk (A-6)

Okeechobee Wood Frame > Monroe and Miami-Dade Wood Frame

Glades, Okeechobee, Martin, Palm Beach, Broward, Miami-Dade Masonry > Monroe Wood Frame

Mobile homes in Monroe < Mobile homes in Miami Dade

The modeler attributed these anomalies to the surface winds resulting from the local friction factors. The modeler indicated that the data base on friction factors is expected to be replaced in the next version of the model. With respect to version 2.5, the Professional

Team could not verify this Standard in light of the above noted relationships. Consequently, the related Standard M-5 is also precluded from verification.

As described under A-6, the Professional Team has concerns relative to the stability of the model from versions 1.5 to 2.0 to 2.5. The model is in its initial stages of public review and has been subject to very large swings as improvements and corrections have been made to the model.

Reviewed revised response under A-10.2 providing the changes from version 1.5 to version 2.0 and revised Form A-6.

Reviewed percentage changes in the output ranges by county from version 1.5 to version 2.5 and from version 2.0 to version 2.5 provided in the revised Form A-7.

Discussed with Agudeo Ingco and Gail Flannery their investigation of anomalies for several counties and different constructions and coverages.

Specific example of the changes in loss costs from version 2.0 to version 2.5 reviewed was Calhoun county Renters Masonry. Reviewed complete damage matrix for ZIP Code 32424 within Calhoun county.

Reviewed the higher loss costs in Miami-Dade county over Monroe county.

An apparent anomaly in the output range loss costs for Calhoun County with zero and $500 deductibles was reviewed and adequately explained by the modeler.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the change in appurtenant structure matrices reverting to those used in version 1.5 for version 2.6. The Professional Team expressed how this further emphasizes concern relative to stability between model versions.

Reviewed the following changes in the model from version 2.5 to version 2.6:

Vulnerability Model Changes – development of revised weak, medium, and strong vulnerability matrices, combination of matrices used when year built is unavailable, and revised allocation of different age groups to different strength categories for the Keys.

Meteorology Model Changes – storm track initialized by using randomly perturbed historical storm location, intensity, and motion 36 hours before landfall, new land use land cover roughness factors (new data and new treatment of the data for centroid roughness), and faster decay of over-land pressures for regions A and D.

Reviewed the use of a separate vulnerability function for appurtenant structure loss costs rather than the previous method of applying a percentage of the structure loss costs.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

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

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

Pre-Visit Letter

109. S-1, page 228 – Referring to paragraph, "For the FHLM…," list the variables that "were fitted through nonparametric methods."

Verified: ~~NO~~ YES

Professional Team Comments:

Modeled versus historical Rmax values were considered in depth. Hurricanes Charley (2004) and Dennis (2005) had Rmax values of 5.75 sm, whereas the 60,000 year stochastic simulation indicates that for similar Pmin values, the lowest Rmax values produced Rmax values no less than 11 sm. Hence, there is a disconnect between the modeled Rmax values and the historical values. There are a number of possible explanations that ought to be explored. The Professional Team performed its own analysis of the data set referenced in Figure 39 and compared the fits to those produced by the modeler. The regression coefficients for the predictor variables matched but the intercept estimate did not. The plot of fitted values versus Rmax data as given on page 230 appears to be a plot of Rmax versus fitted values. Although the transformed response log of Rmax leads to a somewhat larger R^2 value (0.15, adjusted R^2 value of 0.12), the overfit may make it even more difficult to obtain smaller simulated Rmax values. Altering the modeled Rmax distribution would necessitate re-running of the output ranges and other forms that involve the stochastic storm set.

A similar effort was expended in examining the relationship of the Holland B parameter to latitude and delta pressure. Again there is evidence of some overfitting. The relationship examined in this context does not appear to impact the manner in which quantile 1 is used in subsequent standards S-2 and S-3.

A more detailed version of Form S-1 was reviewed. Changes from Version 1.5 in Form S-2 were discussed.

Wind field comparisons were examined in depth beyond the initial submission material.

A document detailing the use of the Poisson versus the negative binomial distribution was reviewed. Both distributions can be shown to pass goodness-of-fit tests for the number of hurricanes in the Atlantic season per season that impact Florida.

*****Additional Verification Review Comments – May 1&2, 2007*****

The fits for the Rmax distribution were examined in detail. Initially, the Professional Team could not reproduce the lognormal and gamma parameter estimates. However, upon further analyses the fits were verified.

Reviewed the changes in the coefficient of variation for all counties provided in the revised histogram, Figure 47.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the revised results in Forms S-1 and S-2 and text for Standard S-1. Errors noted in Form S-2 and subsequently corrected.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

Pre-Visit Letter

110. Form S-5, page 264 – Demonstrate that the values for Holland B for Category 1 on pages 264 and 265 correspond to the given quantiles.

111. Form S-5, page 264 – Justify the distribution used for the Holland B parameter.

112. Form S-5, pages 270-277 – Provide a detailed description of Figures 58-75. Correlate the values of the line printer plots with the corresponding contour plots.

113. Form S-5, page 285 – Provide the contour plots for average percentage loss cost cited to be presented to the Professional Team.

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

Professional Team Comments:

The initially submitted values in Form S-5 were evidently in error and new files were provided the week before the on-site review. Plots associated with the new results were not available during the on-site review. Plots based on the first version of Form S-5 were reviewed in detail and the modeler was able to explain features of them. A detailed explanation of the treatment of quantile 1 was given, which appears to be appropriate.

All plots are to be re-done.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed Form S-5 contour plots.

The resubmitted files were corrected from the previous version. Many of the plots were identical to those generated by the Professional Team.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

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

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

Professional Team Comments:

The initially submitted values in Form S-5 were evidently in error and new files were provided the week before the on-site review. Plots associated with the new results were not available during the on-site review. Plots based on the first version of Form S-5 were discussed in detail and the modeler was able to explain features of them as they relate to uncertainty analysis. A detailed explanation of the treatment of quantile 1 was given, which appears to be appropriate.

All plots need to be produced.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed Form S-5 contour plots.

The resubmitted files were corrected from the previous version. Many of the plots were identical to those generated by the Professional Team.

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:

A plot giving the convergence with sample size was used to confirm the adequacy of the sample size.

*****Additional Verification Review Comments – May 1&2, 2007*****

The simulation size was increased from 60,000 to 61,000 to ensure the appropriate standard error was met.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the appropriateness of a simulation sample size of 50,000.

S-5 Replication of Known Hurricane Losses

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

Audit

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

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

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

4. Form S-3 will be reviewed.

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

Verified: YES

Professional Team Comments:

Hurricane loss data is available for several companies and for storms including Andrew and the 2004 and 2005 seasons. Details regarding the plots given in the disclosures were reviewed. Form S-3 was further examined.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed revised Form S-3 with demand surge included in the modeled losses.

Form S-3 was re-run with both the model-appropriate demand surge model and the Rmax adjustment. No bias was observed. A new demand surge model will necessitate re-running Form S-3.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed the revised Form S-3 with results from the new demand surge 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-4 will be reviewed.

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

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

Professional Team Comments:

Form S-4 will be reviewed again following changes to the stochastic storm set.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed the revised Form S-4.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

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

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

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

Audit

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

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

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

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

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

Pre-Visit Letter

114. Describe how elements and arrow connections in Figure 4 (page 43) relate to modeler personnel interchange and interaction with regard to the Computer Standards. Create a cross-reference between the contents of Table 5 (page 42) and the elements of Figure 4 where applicable.

115. C-1, page 286 – Provide documentation for computer actions taken in the revisions from version 1.5 to version 2.0.

Verified: YES

Professional Team Comments:

Reviewed the Florida Hurricane Loss Model (FHLM) Release 2.0 Primary Document Binder, including:

- FHLM Architecture
- Storm Forecast Module
- Wind field Module
- Damage Estimation Module
- Insurance Estimation Module
- Database Document
- Quality Assurance
- Security
- System Hardware and Software Configuration
- Testing Team Training Plan

Reviewed the documentation for the wind speed correction (WSC) algorithm.

Reviewed separate documentation for three versions of the model (1.0, 1.5, and 2.0).

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed for version 2.5 of the model:

- The document changes made to the Primary Documents Binder stressing the modifications relating to the Rmax model and the use of multiple factors for demand surge by loss type.
- Technical description of the storm track model, comparing the simulated and theoretical Rmax distributions.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed for version 2.6 of the model:

- The document changes made to the Primary Documents Binder stressing the modifications relating to the storm track genesis, the new land use land cover roughness factors, wind speed correction program, wind speed probability program, new vulnerability matrices and the new demand surge model.
- FPHLM Test Report documenting Use Case Testing and Data Testing for all model components.

C-2 Requirements

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

Audit

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

Pre-Visit Letter

116. C-2, page 287 – Provide documentation on the new requirements indicated by revisions from version 1.5 to version 2.0.

Verified: YES

Professional Team Comments:

Reviewed original raw document for wind speed correction (WSC) received from the Meteorology Team.

Reviewed the "use case" for WSC generated from the raw document.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed for version 2.5 of the model:

- Requirements, in the form of equations, specifying demand surge factors for two cases: (1) expected loss costs for a given exposure, and (2) generating scenario-based loss costs.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed for version 2.6 of the model:

- Requirements, in the form of equations, specifying the new demand surge adjustment factor for the NW Florida region.

C-3 Model Architecture and Component Design

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

Audit

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

Pre-Visit Letter

117. C-3, page 288 – Provide documentation cited to be made available to the Professional Team.

118. C-3, page 288 – Describe how the items in the revisions from version 1.5 to version 2.0 are reflected in changes to the model architecture and component design.

Verified: YES

Professional Team Comments:

Reviewed the flowchart for wind speed correction (WSC).

Reviewed the flowchart for producing Form A-5.

Reviewed the overall Oracle database organization and schema.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed for version 2.5 of the model:

- Flowcharts for the demand surge algorithm and demand surge factor calculation
- Wind model code flowchart

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed for version 2.6 of the model:

- Flowchart for application of the new coastal and inland roughness factors
- Class diagram for the coastal and inland roughness factor calculations
- Dataflow diagram for the coastal and inland roughness factor calculations
- Data flow, control flow, and sequence diagrams for the revised demand surge procedures

C-4 Implementation

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

Pre-Visit Letter

119. C-4, pages 289-290 – Show the modified code implementation resulting from revisions from version 1.5 to version 2.0.

Verified: YES

Professional Team Comments:

Verified that the multi-decadal oscillation is not executed.

Reviewed the implementation related to land cover roughness.

Reviewed the wind speed correction (WSC) code.

Verified the correspondence between the wind speed correction (WSC) code against the documentation.

Reviewed the IDL code relating to the derivation and use of form factors for defining storm asymmetry.

Reviewed the coding guidelines.

Reviewed the software component metrics table.

Reviewed code related to deductible loss cost calculation.

Reviewed a glossary created to connect (1) the mathematical terms used as part of the slab boundary layer model, (2) the technical documentation, and (3) the IDL source code.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed for version 2.5 of the model:

- Excel spreadsheet and formulas associated with demand surge estimation
- Excel spreadsheet and formulas associated with standard demand surge adjustment factors
- Noted that one Excel spreadsheet cell value was manually copied from another spreadsheet rather than using direct reference. This practice has the potential to introduce errors and inconsistency
- Code used to read and process the demand surge spreadsheet data
- Verified that 61,000 was used as the number of years for the stochastic storm set simulation

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed for version 2.6 of the model:

- Excel spreadsheet, formulas, and software associated with the new demand surge model
- Excel spreadsheet, formulas, and software associated with the demand surge adjustment factor for the NW Florida region
- Fortran code for the new storm genesis approach
- Fortran code for the new coastal and inland roughness factor calculations
- Java code for the windspeed correction procedure
- Matlab code for revised weight factors used in the new age-weighted vulnerability matrices due to newly acquired insurance data
- Updated software component table with adjusted source code line counts
- Changes to the code to increase the number of significant digits for increased precision
- Enhancements in improved speed due to the use of parallel computation and other methods (e.g. I/O scheduling)

C-5 Verification

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

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

Pre-Visit Letter

120. C-5, pages 291-293 – Describe the code and data testing and verification procedures resulting from the changes from version 1.5 to version 2.0.

121. C-5, pages 291-293 – Provide examples of component and data testing for the following sample areas: 1) wind field calculation, 2) insurance loss estimation, and 3) user interface.

Verified: YES

Professional Team Comments:

Reviewed examples of code inspections and calculation verification.

Reviewed the Florida Hurricane Loss Model (FHLM) Release 2.0 Test Report which contains regression, unit, and aggregation test results for each major module component and data.

*****Additional Verification Review Comments – May 1&2, 2007*****

Reviewed for version 2.5 of the model:

- Testing and quality assurance methods for changes specific to the new version of the model.

*****Second Additional Verification Review Comments – June 18&19, 2007*****

Reviewed for version 2.6 of the model:

- Testing and quality assurance methods for changes specific to the new version of the model as detailed in the FPHLM Test Report binder.

C-6 Model Maintenance and Revision

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

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

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

Audit

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

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

Pre-Visit Letter

122. C-6, page 294 – Provide material cited to be made available to the Professional Team.

123. C-6, page 294 – Describe how changes from version 1.5 to version 2.0 are reflected by the requirements for this Standard.

Verified: YES

Professional Team Comments:

Reviewed the policy for model revision.

Reviewed the method used to manage software checkout and maintenance tracking.

Reviewed the use of CVS relating to a change in the wind field code from version 1.5 to 2.0.

Additional Verification Review Comments – May 1&2, 2007

Reviewed for version 2.5 of the model:

- The use of the open-source Concurrent Versions System (CVS) for managing the time-stamped loss management code containing the demand surge implementation changes.

Second Additional Verification Review Comments – June 18&19, 2007

Reviewed for version 2.6 of the model:

- The use of the new, consistent naming convention for files and documentation
- The use of CVS for revisions to the code related to the new demand surge model

C-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed the procedures for secure access to the software components and data.

Reviewed the backup procedure in the event of a catastrophe.

Reviewed the graphical user interface (GUI) for client access to the model's web-based execution.

*****Additional Verification Review Comments – May 1&2, 2007*****

Verified that access to code and data were accessed appropriately by modeler personnel responsible for relevant access and updates.