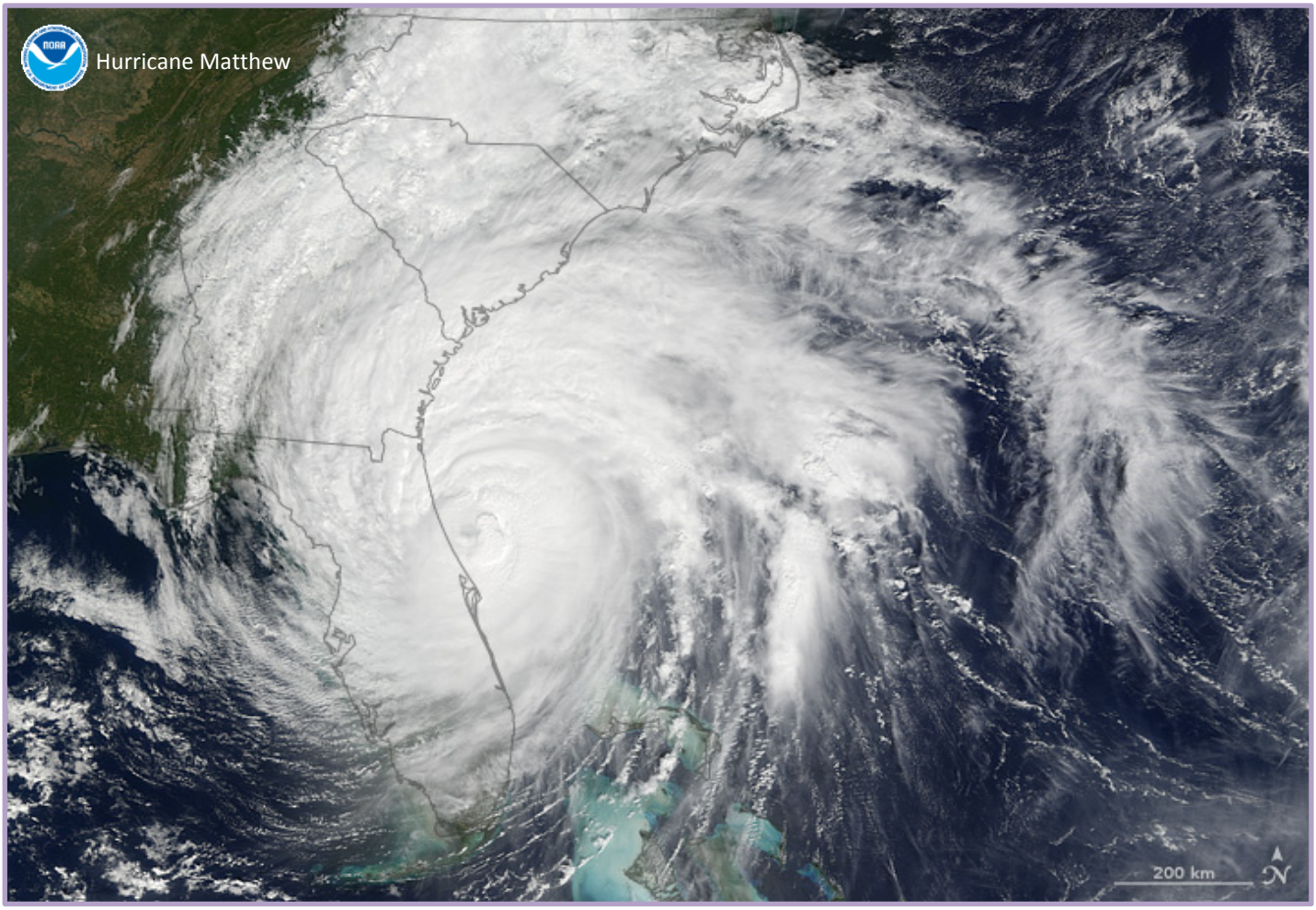
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report

2015 Standards



AIR Worldwide Corporation

On-Site Review

January 9-11, 2017

On January 9-11, 2017, the Professional Team visited AIR Worldwide Corporation (AIR) in Boston, Massachusetts. The following individuals participated in the review:

AIR

Brandie Andrews, CCM, Vice President
Laxmi Balcha, ACA, CL, CCM, Assistant Vice President, Software Development
Sarah Bobby, Ph.D., Engineer, Research and Modeling
Jonathan Cusick, CCM, Analyst, Research and Modeling
Tomas Girnius, Ph.D., Principal Scientist, Manager, Research and Modeling
Jay Guin, Ph.D., Executive Vice President and Chief Research Officer
Anthony Hanson, Senior Principal Analyst, Exposures Group
Cheryl Hayes, Assistant Vice President, Exposures Group, Research and Modeling
Suilou Huang, Ph.D., Senior Scientist, Research and Modeling
Tim Johnson, Ph.D., Engineer, Research and Modeling
Cagdas Kafali, Ph.D., Vice President, Research and Modeling
Karl Kieninger, Senior Database Engineer, Software Development
Jonathan Kinghorn, Senior Writer/Editor, Marketing and Communications
Bahareh (Bria) Kordi, Ph.D., CCM, Senior Engineer, Research and Modeling
Jason Kowieski, CCM, Senior Risk Consultant
Lakshman Nagulapati, Manager Software Quality Assurance
Sylvie Lorsolo, Ph.D., Senior Scientist, Research and Modeling
Farid Moghim, Ph.D., CCM, Senior Engineer, Research and Modeling
Ikram Shaik Mohammed, Security Architect
Dinesh Mohan, Senior Software Quality Assurance Engineer, Product Management
Gayatri Natarajan, CCM, Assistant Vice President, Product Management
Sudhir Potharaju, Senior Vice President, Product Development
Andrew Rahedi, Senior Core Quality Assurance Associate
Karthik Ramanathan, Ph.D., Senior Engineer, Research and Modeling
Barbara Rosenstroch, Senior Technical Writer
Christy Shang, CCM, Senior Risk Consultant
Scott Sperling, CCM, Senior Core Quality Assurance Analyst
Scott Stransky, Assistant Vice President, Principal Scientist, Research and Modeling
Anush Mani Subramanian, Senior Product Consultant, Product Management
Eric Uhlhorn, Ph.D., Principal Scientist, Research and Modeling
Ekatherina Wagenknecht, Risk Analyst
Heidi Wang, FCAS, CCM, Senior Manager Business Development
Alexander Wong, Senior Software Engineer
Yili Yao, Principal Database Engineer

Professional Team

Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Michael Smith, FCAS, FSA, MAAA, OMCAA, Actuary
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process. AIR discussed their responses to the deficiencies and additional changes in the submission that were provided with the deficiency responses.

- Standard G-1, Disclosure 5.B – change to the percentage change in the model and the two maps for the Vulnerability and Geographic/Other model changes. The changes were due to a correction to one of the input files used to calculate the percentage changes by model component. An error was made in assigning the ZIP Code centroid to a grid location. Verified the error was isolated to the response in Disclosure 5.B and C and did not impact the model or any other information in the submission. AIR discussed how the error occurred and the procedure implemented to prevent this type of error from reoccurring.
- Standard G-1, Disclosure 6 – removed incorrect sentence.
- Standard G-2, Disclosure 2.B – corrected Dr. Carol Friedland's qualifications.
- Standard G-2, Disclosure 5 – removed Prashant Annabattuni from list of Computer Science employees as Prashant left AIR in November 2016.
- Standard M-2, Disclosure 9 – corrected data in Figure 10 to use the current version of the historical hurricane frequency.
- Form S-4 – removed two sections in Table 40.
- Form A-5 – revised the display of county boundary lines in the Figures 89-96 maps to be consistent with the county boundaries in Standard G-1, Disclosure 5 maps.

AIR next provided a general overview of the model updates including updating the historical and stochastic hurricane catalogs, the ZIP Code and industry exposure databases, the methodology for validating and back-filling address information during the import process of latitude/longitude data, and vulnerability function updates to be relevant through 2016 for year built unknown, structural aging and building technology factors changes, and building code related updates. New vulnerability functions were developed for buildings built to the Florida Building Code 2010 requirements, and enhancements were made to secondary risk features for certified structures, roof year built, seal of approval, and secondary water resistance options. These changes resulted in an overall 0.1% decrease in modeled loss costs. AIR discussed other software enhancements made to improve functionality of the model.

During the review of the secondary vulnerability modifiers, a conditional branching statement error relating to the non-contiguous windspeed ranges was discovered in the previous accepted version. The Professional Team reviewed with the modeler the process and requirements in the *Report of Activities* if there is a discovery of differences in a model after the model has been found acceptable by the Commission. AIR intends to notify the Commission of this discovery of differences.

The Professional Team recommends AIR present the following information to the Commission during the Trade Secret session of the meeting to review the model for acceptability:

1. Justification for the construction classes and characteristics used in the model.
2. Justification for modifications to the building vulnerability functions due to building codes and their enforcement including use of year of construction and/or geographical location of the building if used as a surrogate for building code and code enforcement.
3. Methodology for reinforced masonry and the exposure data and its consistency with the prevailing Florida Building Code and code enforcement.
4. Method for excluding storm surge losses from the modeled losses.
5. Monroe County specialized analysis.

6. Detailed information and discussion of Form V-3 as specified on page 55 of the *Report of Activities*.
7. Detailed information and discussion of relativities in Form A-6 as specified on pages 55-56 of the *Report of Activities*.

The Professional Team reviewed the following corrections to be included in the revised submission to be provided to the Commission no later than 10 days prior to the meeting to review the model for acceptability. Page numbers below correspond to the November 2016 revised submission.

1. Page 28, G-1, Disclosure 5 – revised to include change to gridded format for unknown year-built factors, update to Individual Risk Module to operate on a grid, and technical update to the storm surge model, and revised to remove reference to secondary risk feature.
2. Page 63, M-1, Disclosure 1 – revised to correct HURDAT reference to HURDAT2.
3. Page 66, M-2, Disclosure 3 – revised to correct HURDAT reference to HURDAT2.
4. Page 84, M-6, Disclosure 3 – revised to correct HURDAT references to HURDAT2.
5. Page 111, V-1, Disclosure 1 – revised to remove reference to secondary risk feature.
6. Page 138, V-3.A – revised to reword knowledge-based expert system to engineering based framework.
7. Page 139, V-3, Disclosure 1 – revised to remove reference to secondary risk feature.
8. Page 140, V-3, Disclosure 4 – revised to reword knowledge-based expert system to engineering based framework.
9. Page 148, A-1, Disclosure 5 – Table 21 revised to move application of policy limit and deductible under Optional Settings.
10. Page 196, CI-5, Disclosure 3 – Table 33 revised to reflect updates to historical catalog given in Standard M-1.
11. Pages 219-220, Form M-1 and Figure 64 – revised to correct historical hurricane frequencies actually used to develop the stochastic hurricane catalog and to explain differences with Form A-2.
12. Page 259, Form V-1 – revised to correct reference to disclosure 14.
13. Page 406, Appendix 8 – revised to correct HURDAT references to HURDAT2.
14. Page 413, Appendix 9 – revised to include Individual Risk Model (IRM).
15. Pages 413, 414, 419 and 430, Appendix 9 – revised to reword knowledge-based expert system to engineering based framework.
16. Page 449, Appendix 11 – revised to include IRM – Individual Risk Model.

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the December 13, 2016 meeting. The deficiencies were eliminated by the established time frame, and the modifications have been verified.

1. Standard G-1, Disclosure 5.C (pages 30-34)
   Response is non-responsive as the maps in Figures 4-8 do not comply with county boundaries as required in the disclosure.

2. Standard S-1, Disclosure 2 (pages 89-90)
   Response is non-responsive as the legends in Figures 17 & 18 do not follow the Acceptability Process II.A.5.j requirements (page 49) in the *Report of Activities*.

3. Standard V-1, Disclosure 8 (pages 123-124)
   Response is incomplete as a description of the relationship between structural and appurtenant structure vulnerability functions and consistency with insurance claims data are not given.

4. Standard V-2, Disclosure 4 (page 134)
   Response is incomplete as the total number of contents vulnerability functions is not given.

5. Standard V-3.A (page 138)
   Response is incomplete as the impact of mitigation measures on associated uncertainties is not given.

6. Form A-1.C (page 274)
   Response is incomplete as Form A-1 was not provided in PDF format.

7. Form A-8 (page 370)
   Response is deficient as the axes are problematic in Figure 97.

Discussion on Inquiries

The Professional Team discussed the following inquiries identified by the Commission at the December 13, 2016 meeting. The Professional Team will prepare a report on the inquiries to the Commission after discussions with all modelers are complete and prior to the 2017 standards committee meetings.

1. Investigate the condo-unit floor location impact on loss costs. How is lack of floor location treated?

2. Investigate aspects of the model and inputs that could lead to the greatest reduction in the uncertainty in model outputs (e.g., hurricane frequency, damage functions, incorrect data input, granularity of exposure location (ZIP Code centroid versus street address) data input).

3. Investigate how contamination of claims data (flood loss counted as wind loss) impacts validation and model output.

4. Investigate how the treatment of inland versus coastal exposures has an effect on the spatial evaluation of vulnerability functions.

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

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

It is important that all material prepared for presentation during the on-site review be presented using a medium that is readable by all members of the Professional Team simultaneously.

The on-site schedule is tentatively planned to proceed in the following sequence: (1) presentation by the modeler of new or extensively updated material related to the model; (2) section by section review commencing within each section with pre-visit letter responses; (3) responses to new or significantly changed standards in the 2015 *Report of Activities*, and (4) responses to the audit items for each standard in the *Report of Activities*.

Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2012 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2012 FHCF exposure data.

If changes have been made in any part of the model or the modeling process from the descriptions provided in the original 2015 submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and all revised forms where any output changed.

Refer to the On-Site Review section of the *Report of Activities as of November 1, 2015* for more details on materials to be presented to the Professional Team. Please pay particular attention to the requirements under Presentation of Materials on pages 73-74. In addition, please provide six printed copies of the tables required in Standard CI-1, Audit 6.

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

The pre-visit comments are grouped by standards sections.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Model and Its Implementation*

*(*Significant Revision)*

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

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

C. All software and data (1) located within the model, (2) used to validate the model, (3) used to project modeled loss costs and probable maximum loss levels, and (4) used to create forms required by the Commission in the Report of Activities shall fall within the scope of the Computer/Information Standards and shall be located in centralized, model-level file areas.

Audit

1. All representative or primary technical papers that describe the underlying model theory and implementation (where applicable) should be available for review in hard copy or electronic form. Modeling organization specific publications cited must be available for review in hard copy or electronic form.

2. Compliance with the process prescribed in Standard G-1.B in all stages of the modeling process will be reviewed.

3. Items specified in Standard G-1.C will be reviewed as part of the Computer/ Information Standards.

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

5. The following information related to changes in the model, since the initial submission for each subsequent revision of the submission, will be reviewed.

   A. Model changes:
      1. A summary description of changes that affect, or are believed to affect, the personal or commercial residential loss costs or probable maximum loss levels,
      2. A list of all other changes, and
      3. The rationale for each change.

   B. Percentage difference in average annual zero deductible statewide loss costs based on the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named "hlpm2012c.exe" for:
      1. All changes combined, and
      2. Each individual model component and subcomponent change.

C. For any modifications to Form A-4, Output Ranges, since the initial submission, additional versions of Form A-5, Percentage Change in Output Ranges:
   1. With the initial submission as the baseline for computing the percentage changes, and
   2. With any intermediate revisions as the baseline for computing the percentage changes.

D. Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide loss costs based on the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named "hlpm2012c.exe" for each model component change:
   1. Between the previously accepted model and the revised model,
   2. Between the initial submission and the revised submission, and
   3. Between any intermediate revisions and the revised submission.

Pre-Visit Letter

1. Carol Friedland, signatory on the Vulnerability Standards Expert Certification Form G-4, needs to be available for the on-site review.

2. G-1, Disclosure 5.C, Figures 4, 6 & 7, pages 30, 32 & 33: Explain counties with zero (0.000) percent change.

3. G-1, Disclosure 5.C, Figure 6, page 32: Explain the large increase and large decrease of vulnerability impact on the neighboring counties of Escambia and Santa Rosa, respectively.

4. G-1, Disclosure 5.C, Figure 7, page 33: Explain the large increase and large decrease of Geographic or Other Data impact on the neighboring counties of Gulf and Franklin, respectively.

5. G-1, Disclosure 5.D, Figure 8, page 34: Explain the zero change in Marion County for Total impact while there are changes for the same county for individual Event Generation, Vulnerability, and Geographic or Other Data changes in the model.

6. G-1, Disclosure 5.D, Figure 8, page 34: Provide details of loss costs for Franklin and Gulf counties where the minimum and maximum for total percentage impact are located. Compare the values for the same counties for impact of individual components (i.e., Event Generation, Vulnerability, and Geographic or Other Data changes).

Verified: YES

Professional Team Comments:

AIR discussed how an error was discovered while preparing an answer to pre-visit letter question #3 in the calculation of the loss cost percentage changes due to the model changes in the vulnerability component. Reviewed process flowchart used to create the underlying data for the percentage change maps in Standard G-1, Disclosure 5.B. Discussed enhanced process for validation of input data files to eliminate this type of error from occurring in the future.

Discussed AIR's process for updating the ZIP Code database annually and the methodology used for applying ZIP Code centroids in the off submission years.

Discussed how zero percentage change values can appear in the percent change loss cost maps and the reason for the methodology applied.

The correction to Figure 6 moved the maximum increase of the vulnerability impact from Escambia County to Gulf County eliminating the large increase next to the large decrease in neighboring Santa Rosa County.

Discussed the reasons for the large increase and the large decrease in loss costs for neighboring Gulf and Franklin counties due to county geographical updates.

Discussed the technical update to the Storm Surge model impacting hurricane wind losses.

Reviewed the loss costs for Franklin and Gulf counties.

G-2 Qualifications of Modeling Organization Personnel and Consultants Engaged in Development of the Model

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

B. The model and model submission documentation shall be reviewed by modeling organization personnel or consultants in the following professional disciplines with requisite experience: structural/wind engineering (licensed Professional Engineer), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society or Society of Actuaries), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall certify Forms G-1 through G-6, Expert Certification forms, as applicable.

Audit

1. The professional vitae of personnel and consultants engaged in the development of the model and responsible for the current model and the submission will be reviewed. Background information on the professional credentials and the requisite experience of individuals providing testimonial letters in the submission will be reviewed.

2. Forms G-1, General Standards Expert Certification, G-2, Meteorological Standards Expert Certification, G-3, Statistical Standards Expert Certification, G-4, Vulnerability Standards Expert Certification, G-5, Actuarial Standards Expert Certification, G-6, Computer/Information Standards Expert Certification, 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. Incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession will be discussed.

4. For each individual listed under Disclosure 2.A, specific information as to any consulting activities and any relationship with an insurer, reinsurer, trade association, governmental entity, consumer group, or other advocacy group within the previous four years will be reviewed.

Pre-Visit Letter

7. G-2, Disclosure 2.B, page 50: Provide resumes of new personnel.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Sarah Bobby, Ph.D., Structural Engineering, University of Notre Dame, Notre Dame, IN; B.S., Civil Engineering, University of Notre Dame, South Bend, IN
- Broto Chakrabarti, PMP, CSM, CSPO, B.C., Business, Bhawanipore College, Kolkata, India
- Jonathan Cusick, B.S., Natural Resources Ecology, University of Vermont, Burlington, VT
- Burcu Davidson, M.S., Computer Science, Suffolk University, Boston, MA; B.S., Electronics and Communication Engineering, Istanbul Technical University, Istanbul, Turkey
- Jonathan Dodds, B.A., Computer Science, University of Massachusetts at Boston, Boston, MA
- Tim Johnson, Ph.D., Civil Engineering, Florida Institute of Technology, Melbourne, FL; M.S. Civil Engineering, Florida Institute of Technology, Melbourne, FL; B.S. Civil Engineering, Florida Institute of Technology, Melbourne, FL
- Kiran Kalvagadda, M.S., Computer Science, Central Michigan University, Mt. Pleasant, MI; B.S., Computer Science and Engineering, RGMCET, India
- Karl Kieninger, B.S., Economics, University of Virginia, Charlottesville, VA
- Visweswara Kokkonda, B.T., Electronics and Communication Engineering, Jawaharlal Nehru Technology University, Hyderabad, India
- Bahareh Kordi, Ph.D., CCM, Wind Engineering, University of Western Ontario, London, Canada; M.S., Civil Engineering, Sharif University of Technology, Tehran, Iran; B.S., Civil Engineering, Amirkabir University, Tehran, Iran.
- Jason Kowieski, B.S., Mathematics-Actuarial Science & Economics, University of Wisconsin-Eau Claire, Eau Claire, WI
- Alex McCollom, B.S., Mathematics, Boston University, Boston, MA
- Farid Moghim, Ph.D., Civil Engineering, Northeastern University, Boston, MA; M.S., Earthquake Engineering, Isfahan University of Technology, Isfahan, Iran; B.S. Civil Engineering, Isfahan University of Technology, Isfahan, Iran
- Ikramuddin Shaik Mohammed, CISA, CCSK, M.C.A., Osmania University, Hyderabad, India; B.S. India
- Dinesh Mohan, B.S., Computer Engineering, Michigan State University, East Lansing, MI
- Siva Lakshman Rao Nagulapati, M.C.A., Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Enathur, Kanchipuram, Tamil Nadu, India
- Ryan Ogiste, B.A., Business and Communications, Providence College, Providence, RI
- Barbara Rosenstroch, M.E., Applied Physics and Nuclear Engineering, Cornell University, Ithaca, NY; B.S., Nuclear Engineering, Columbia University, New York, NY
- Indumathi Sagyari, B.E., Computer Science, Vallurupalli Nageswara Rao Vignana Jyothi Institute of Engineering and Technology, Hyderabad, India
- Scott Sperling, B.A., Economics, Boston University, Boston, MA
- Eric Uhlhorn, Ph.D., Meteorology and Physical Oceanography, University of Miami, Miami, FL; M.S., Physical Oceanography, Florida Institute of Technology, Melbourne, FL; B.S. Meteorology, Florida State University, Tallahassee, FL

- Ekatherina Wagenknecht, B.S., Earth, Environmental and Ocean Sciences, University of Massachusetts-Boston, Boston, MA; A.S., Liberal Arts, Massasoit Community College, Brockton, MA
- Nicholas Wainer, B.C., Wentworth Institute of Technology, Boston, MA
- Richard Yablonsky, Ph.D., CCM, Oceanography, University of Rhode Island, Narragansett, RI; M.S., Atmospheric Science, North Carolina State University, Raleigh, NC; B.S., Meteorology, North Carolina State University, Raleigh, NC; B.A., Chemistry, North Carolina State University, Raleigh, NC
- Jiaxin Yu, B.S., Environmental Science, University of Vermont, Burlington, VT

Discussed that there were no departures of personnel attributable to violations of professional standards.

G-3 Insured Exposure Location

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

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

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

D. If any hazard or any model vulnerability components are dependent on ZIP Code databases, the modeling organization shall maintain a logical process for ensuring these components are consistent with the recent ZIP Code database updates.

E. Geocoding methodology shall be justified.

Audit

1. Geographic displays for all ZIP Codes will be reviewed.
2. Geographic comparisons of previous to current locations of ZIP Code centroids will be reviewed.
3. Third party vendor information, if applicable, and a complete description of the process used to validate ZIP Code information will be reviewed.
4. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.
5. Examples of geocoding for complete and incomplete street addresses will be reviewed.
6. Examples of latitude-longitude to ZIP Code conversions will be reviewed.
7. Model ZIP Code-based databases will be reviewed.

Pre-Visit Letter

8. G-3, Disclosures 4 & 5, pages 59-60: Explain why the distance from coastline, elevation, and surface roughness databases (page 35) are not included in the list of databases given in G-3, Disclosures 4 and 5.

Verified: YES

Professional Team Comments:

Reviewed geographic displays of ZIP Codes and comparisons of centroid movements for the entire state. Reviewed in detail the ten Florida ZIP Codes that experienced the largest centroid movements.

Reviewed flowchart and discussed the methodology for validating ZIP Code centroids.

Discussed no change in the treatment of ZIP Code centroids over water.

Discussed new methodology for conversion of latitude-longitude positions to ZIP Codes. Discussed methodology for validating and back-filling address information. Reviewed workflow for reverse geocoding.

Discussed the error made in assigning ZIP Code centroids to a grid location in one of the input files used to calculate the percentage changes by model component. Verified the error was isolated to the response in Disclosure 5.B and C and did not impact the model or any other information in the submission. Discussed the procedure implemented to prevent the error from reoccurring.

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. The model components will be reviewed for adequately portraying hurricane phenomena and effects (damage, loss costs, and probable maximum loss levels). Attention will be paid to an assessment of (1) the theoretical soundness of each component, (2) the basis of the integration of each component into the model, and (3) consistency between the results of one component and another.

2. All changes in the model since the previous submission that might impact the independence of the model components will be reviewed.

Verified: YES

Professional Team Comments:

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

G-5 Editorial Compliance

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

Audit

1. An assessment that the person(s) who has reviewed the submission has experience in reviewing technical documentation and that such person(s) is familiar with the submission requirements as set forth in the Commission's Report of Activities as of November 1, 2015 will be made.

2. Attestation that the submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and no inclusion of extraneous data or materials will be assessed.

3. Confirmation that the submission has been reviewed by the signatories on Forms G-1 through G-6, Expert Certification forms, for accuracy and completeness will be assessed.

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

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

6. Form G-7, Editorial Review Expert Certification, will be reviewed.

Verified: YES

Professional Team Comments:

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

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. The Base Hurricane Storm Set is the National Hurricane Center HURDAT2 as of June 9, 2015 (or later), incorporating the period 1900-2014. Annual frequencies used in both model calibration and model validation shall be based upon the Base Hurricane Storm Set. Complete additional season increments based on updates to HURDAT2 approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these data. Peer reviewed atmospheric science literature may be used to justify modifications to the Base Hurricane Storm Set.

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

Audit

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

2. A flowchart illustrating how changes in the HURDAT2 database are used in the calculation of landfall distribution will be reviewed.

3. Changes to the modeling organization Base Hurricane Storm Set from the previously accepted model will be reviewed. Any modification by the modeling organization to the information contained in HURDAT2 will be reviewed.

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

5. Modeled probabilities will be compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical statewide and regional hurricane frequencies as provided in Form M-1, Annual Occurrence Rates, will be reviewed.

6. Form M-1, Annual Occurrence Rates, will be reviewed for consistency with Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year.

7. Comparisons of modeled probabilities and characteristics from the complete historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against the complete HURDAT2 database. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete HURDAT2 database.

Pre-Visit Letter

9. M-1, page 63: Changes in the Base Hurricane Storm Set will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the new historical catalog based on HURDAT2 as of September 29, 2015.

Reviewed the following updates to the historical catalog:

- Nineteen storms were modified due to the HURDAT2 reanalysis project (1946-1955) and HURDAT2 storm updates in later years
- One Florida landfall was added, Hurricane Hazel (1953)
- Landfall coastal segments for two Florida landfalls were changed, Hurricane Easy (1950) and NoName04 (1947).

Reviewed comparison of previous and current hurricane track changes and comparison maps of the spatial distribution of winds with storm tracks plotted for NoName01 (1928), NoName06 (1946), NoName04 (1947), NoName09 (1947), NoName08 (1948), NoName09 (1948), NoName02 (1949), Hurricane Baker (1950), Hurricane King (1950), Hurricane Florence (1953), Hurricane Hazel (1953), Hurricane Camille (1969), Hurricane Kate (1985), Hurricane Floyd (1987), Hurricane Danny (1997), Hurricane Irene (1999), Hurricane Gordon (2000), and Hurricane Frances (2004).

Reviewed flowchart for adding supplemental landfall information for storms where the information was not explicitly provided in HURDAT2.

Discussed the methodology for determining central pressure at landfall via a wind pressure relationship when central pressure is not provided in HURDAT2.

Discussed no short term variations used or temporal partitioning done to the historical data.

Discussed the error discovered in the compilation of Form M-1. Reviewed a revised flowchart of process to complete Form M-1.

Discussed that the errors in Form M-1 did not impact the stochastic hurricane catalog.

Reviewed modeler's approach to implementing the definition of a hurricane as given in the Florida Statutes and how this impacted Forms M-1 and A-2 differently.

Reviewed corrected Form M-1 and compared with Form A-2. Discussed the 17 additional storms in AIR's Base Hurricane Storm Set in Form A-2 that are not included in Form M-1. A explanatory footnote has been added to revised Form M-1.

Determined that the corrected Form M-1 is consistent with Form S-1.

M-2 Hurricane Parameters and Characteristics

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

Audit

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

2. Graphical depictions of hurricane parameters as used in the model will be reviewed. Descriptions and justification of the following will be reviewed:
   a. The dataset basis for the fitted distributions, the methods used, and any smoothing techniques employed,
   b. The modeled dependencies among correlated parameters in the windfield component and how they are represented, and
   c. The asymmetric structure of hurricanes.

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

4. Scientific literature cited in Standard G-1, Scope of the Model and Its Implementation, may be reviewed to determine applicability.

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

6. Description of and justification for the value(s) of the far-field pressure used in the model will be reviewed.

Verified: YES

Professional Team Comments:

Discussed no changes in modeled hurricane parameters.

Discussed no change in the gradient wind reduction factor or peak weighting factor.

Reviewed scatter plots and the transformation for the peak weighting factor and gradient wind reduction factor fits.

M-3 Hurricane Probabilities

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

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

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

Saffir-Simpson Hurricane Scale:

Category	Winds (mph)	Damage
1	74 – 95	Minimal
2	96 – 110	Moderate
3	111 – 129	Extensive
4	130 – 156	Extreme
5	157 or higher	Catastrophic

Audit

1. Demonstration of the quality of fit extending beyond the Florida border will be reviewed by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.

2. The method and supporting material for selecting stochastic storm tracks will be reviewed.

3. The method and supporting material for selecting storm track strike intervals will be reviewed. If strike locations are on a discrete set, the landfall points for major metropolitan areas in Florida will be reviewed.

4. Any modeling organization specific research performed to develop the functions used for simulating model variables or to develop databases will be reviewed.

5. Form S-3, Distributions of Stochastic Hurricane Parameters, will be reviewed for the probability distributions and data sources.

Verified: YES

Professional Team Comments:

Reviewed goodness-of-fit tests for coastal segments in Alabama, Georgia, and Mississippi.

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

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

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

B. The land use and land cover (LULC) database shall be consistent with National Land Cover Database (NLCD) 2011 or later. Use of alternate datasets shall be justified.

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

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

Audit

1. Any modeling organization-specific research performed to develop the windfield functions used in the model will be reviewed. The databases used will be reviewed.

2. Any modeling organization-specific research performed to derive the roughness distributions for Florida and neighboring states will be reviewed.

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

4. The previous and current hurricane parameters used in calculating the loss costs for the LaborDay03 (1935) and NoName09 (1945) landfalls will be reviewed. Justification for the choices used will be reviewed. The resulting spatial distribution of winds will be reviewed with Form A-2, Base Hurricane Storm Set Statewide Losses.

5. For windfields not previously reviewed, detailed comparisons of the model windfield with Hurricane King (1950), Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005) will be reviewed.

6. For windfield and pressure distributions not previously reviewed, time-based contour animations (capable of being paused) demonstrating scientifically reasonable windfield characteristics will be reviewed.

7. Representation of vertical variation of winds in the model, where applicable, will be reviewed.

8. Form M-2, Maps of Maximum Winds, will be reviewed.

Pre-Visit Letter

10. M-4, Disclosure 10, pages 78-79: Provide scatter plot for Hurricane King (1950).

Verified: YES

Professional Team Comments:

Reviewed scatter plot for Hurricane King (1950) and the underlying data.

Discussed no change in the land use and land cover database from the National Land Cover Database 2011 data.

Reviewed the list of storms used to derive turbulence intensity statistics for use in Florida and neighboring states.

Reviewed storm track maps for LaborDay03 (1935) and NoName 09 (1945) storms.

Reviewed comparisons of the model windfield footprints for Hurricane Charley (2004), Hurricane Jeanne (2004), Hurricane Wilma (2005), and Hurricane King (1950).

Reviewed maps of maximum winds provided in Form M-2.

M-5 Landfall and Over-Land Weakening Methodologies

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

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

Audit

1. The variation in over-land decay rates used in the model will be reviewed.

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

3. The detailed transition of winds from over-water to over-land (i.e., landfall, boundary layer) will be reviewed. The region within 5 miles of the coast will be emphasized. Color-coded snapshot maps of roughness length and spatial distribution of over-land and over-water windspeeds for Hurricane Jeanne (2004), Hurricane Dennis (2005), and Hurricane Andrew (1992) at the closest time after landfall will be reviewed.

Verified: YES

Professional Team Comments:

Discussed no change in over-land decay rates.

Reviewed comparison of model weakening rates to historical Florida hurricane weakening rates.

Reviewed color-contour snapshot maps of windspeed and roughness length for Hurricane Andrew (1992), Hurricane Jeanne (2004), and Hurricane Dennis (2005).

Reviewed windspeed and roughness length maps at high resolution for onshore and offshore flow at landfall for Hurricane Andrew (1992), Hurricane Jeanne (2004), and Hurricane Dennis (2005).

Reviewed color-contour animation of the landfall of Hurricane Frances (2004).

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

1. Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, and the modeling organization's sensitivity analyses will be reviewed.

2. Justification for the relationship between central pressure and radius of maximum winds will be reviewed. The relationships among intensity, Rmax, and their changes will be reviewed.

3. Justification for the variation of the asymmetry with the translation speed will be reviewed.

4. Methods (including any software) used in verifying these logical relationships will be reviewed.

Pre-Visit Letter

11. Form M-3, page 230: The wind-pressure relation for weaker storms (higher pressure) will be reviewed.

Verified: YES

Professional Team Comments:

Discussed methodology for computing modeled winds and completion of Form M-3.

Discussed approach to determining the selection of distributions for hurricane parameters as they relate to hurricane characteristics.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

B. Modeled and historical results shall reflect statistical agreement using currently accepted scientific and statistical methods for the academic disciplines appropriate for the various model components or characteristics.

Audit

1. Forms S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, S-2, Examples of Loss Exceedance Estimates, and S-3, Distributions of Stochastic Hurricane Parameters, will be reviewed. Justification for the distributions selected, including for example, citations to published literature or analyses of specific historical data, will be reviewed.

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

Pre-Visit Letter

12. S-1, Disclosure 1, page 86: Provide full details on all of the updated distributional fits.

13. S-1, Disclosure 6, Figure 19, page 91: Provide the details on the negative binomial fit including the raw counts.

14. S-1, Disclosure 6, Figure 21, page 93: As all the simulated annual frequencies are below the historical frequencies, provide analogous figures for the other 100 mile segments.

15. Form S-2, page 237: Provide the track of the top event.

16. Form S-3, pages 240-241: Provide further details (beyond page 87) on the Gradient Wind Reduction Factor and Peak Weighting Factor fits (inverse power transformation used, correlation between the two, goodness-of-fit).

Verified: YES

Professional Team Comments:

Reviewed distribution of overall historical annual landfall frequency and landfall frequencies by 50-mile coastal segments.

Reviewed the details for the negative binomial fit for number of landfalls per year.

Reviewed distributional fits for annual landfall frequency for 100-mile segments.

Reviewed storm track of the top event for both annual aggregate and annual occurrence cases.

Reviewed details on the gradient wind reduction factor and peak weighting factor fits. Reviewed plots of fitted distributions.

Reviewed various Chi-square and Kolmogorov-Smirnov goodness-of-fit tests.

Reviewed plots of Form S-4 validation comparisons by event, coverage type, construction type, and by county level.

Reviewed change in Figure 22 from the previous submission related to the exposure for Hurricane Andrew (1992) shifting with the change in the ZIP Code centroid.

Reviewed Form S-1 compared to Form M-1, previous submission and HURDAT2 updates.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

2. Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Discussed no changes in model methodology from the previous submission.

Verified that no new sensitivity tests were required.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

2. Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Discussed no changes in model methodology from the previous submission.

Verified that no new uncertainty tests were required.

S-4 County Level Aggregation

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

Audit

1. A graph assessing the accuracy associated with a low impact area such as Nassau County will be reviewed. If the contribution error in an area such as Nassau County is small, the expectation is that the error in other areas would be small as well. The contribution of simulation uncertainty via confidence intervals will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the use of a constrained Monte Carlo approach to generate the stochastic catalog. Reviewed convergence results for Nassau, Lee, Levy, Putnam, Franklin, Hillsborough, and Okaloosa counties.

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 modeling organization. This standard applies separately to personal residential and, to the extent data are available, to commercial residential. Personal residential loss experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail and shall include loss data from both 2004 and 2005.

Audit

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

2. The following documentation will be reviewed:
   a. Publicly available documentation referenced in the submission in hard copy or electronic form,
   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, and
   d. User input data for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

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

4. Form S-4, Validation Comparisons, will be reviewed.

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

Pre-Visit Letter

17. Form S-4, Comparison #7, page 246: Provide an explanation for all of the modeled losses exceeding the actual losses.

Verified: YES

Professional Team Comments:

Reviewed Form S-4 results. Discussed the reason for the two sections removed from Table 40 that were redundant and outdated.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled, will be reviewed for consistency with Standard G-1, Scope of the Model and Its Implementation, Disclosure 5.

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

Verified: YES

Professional Team Comments:

Reviewed Form S-5.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Building Vulnerability Functions*

*(*Significant Revision)*

A. Development of the building vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) laboratory or field testing, (3) rational structural analysis, and (4) post-event site investigations. Any development of the building vulnerability functions based on rational structural analysis, post-event site investigations, and laboratory or field testing shall be supported by historical data.

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

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

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

E. Vulnerability functions shall be separately derived for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures.

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

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

Audit

1. Modifications to the building vulnerability component in the model since the previously accepted model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impacts on the building vulnerability component. Comparisons with the previously accepted model will be reviewed.

2. Historical data in the original form will be reviewed with explanations for any changes made and descriptions of how missing or incorrect data were handled. When historical data is used to develop building vulnerability functions, the goodness-of-fit of the data will be reviewed. Complete reports detailing loading conditions and damage states for any laboratory or field testing data used will be

reviewed. When rational structural analysis is used to develop building vulnerability functions, such analyses will be reviewed for a variety of different building construction classes. Laboratory or field tests and original post-event site investigation reports will be reviewed.

3. All papers, reports, and studies used in the continual development of the building vulnerability functions must be available for review in hard copy or electronic form.

4. Multiple samples of building vulnerability functions for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures will be reviewed. The magnitude of logical changes among these items for a given windspeed and validation materials will be reviewed.

5. Justification for the construction classes and characteristics used will be reviewed.

6. Validation of the building vulnerability functions and associated uncertainties will be reviewed.

7. Documentation and justification for all modifications to the building vulnerability functions due to building codes and their enforcement will be reviewed. If year of construction and/or geographical location of building is used as a surrogate for building code and code enforcement, complete supporting information for the number of year of construction groups used as well as the year(s) and/or geographical region(s) of construction that separates particular group(s) will be reviewed.

8. Validation material for the disclosed minimum windspeed will be reviewed. The computer code showing the inclusion of the minimum windspeed at which damage occurs will be reviewed.

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

10. How the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify building vulnerability functions will be reviewed. Examples include the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.

11. The percentage of damage at or above which the model assumes a total loss will be reviewed.

12. Form V-1, One Hypothetical Event, will be reviewed.

Pre-Visit Letter

18. V-1.D, page 110: Describe the Individual Risk Model referred to throughout the submission and discuss the associated updates.

19. V-1, Disclosure 1, page 111: Explain the change in year bands from 2002-2008 and post-2008 to 2002-2011 and post-2011.

20. V-1, Disclosures 3 & 4, pages 112-119: Explain, in spite of significant changes to the vulnerability component, the “Simulated” versus “Actual” comparisons in Figures 30-38 remain unchanged.

21. V-1, Disclosure 5, page 120: Discuss the masonry building systems as they relate to constructions in Florida. Present comparison charts.

22. V-1, Disclosure 8, pages 123-124: Explain, in spite of significant changes to the vulnerability component, the "Modeled" versus "Actual" comparison in Figure 39 remains unchanged.

Verified: YES

Professional Team Comments:

Discussed with Dr. Carol Friedland her review of the model updates in the vulnerability component. Confirmed there were no unresolved issues resulting from her review.

Reviewed the enhancements to the building vulnerability functions and technical updates listed in Standard G-1, Disclosure 5.

Discussed how the model accounts for spatial and temporal variation in vulnerability by capturing the evolution of building codes, the corresponding wind load standards, and the adoption and enforcement of the Florida Building Code.

Reviewed the year-built bands based upon the Florida Building Code versions and effective dates. Discussed their review of the 2014 Florida Building Code.

Discussed that a model user cannot change the base vulnerability functions or the modification functions. The user has the option to select which secondary risk features are applied, but cannot change the function itself.

Reviewed AIR's analysis of the different Florida Building Code versions and ASCE-7 design wind load standards and the application of the building codes and their enforcement in development of the building vulnerability functions.

Reviewed the key changes to the ASCE 7-10 wind load standards. Reviewed the new design windspeed maps for Florida and changes to the wind-borne debris region.

Reviewed model building assumptions based on construction compliance with the 2010 Florida Building Code.

Discussed no change in the number of building classes after incorporation of the latest building codes and wind load standards in Florida.

Discussed construction built in 2012 and later have new vulnerability functions.

Discussed application of the roof age band update.

Reviewed the updates to unknown year-built damage functions.

Discussed masonry related building classes.

Reviewed treatment of reinforced masonry. Discussed the reinforced and unreinforced masonry damage functions for Florida. Discussed masonry wall reinforcement and roof to wall connections in masonry construction.

Discussed how results from damage surveys might influence damage probability distributions.

Reviewed justification and documentation for modifications to building damage functions based on building code requirements and level of enforcement.

Discussed uncertainty in modeled windspeed at a location for a given storm and the impact of mitigation measures on the uncertainty in the vulnerability.

Reviewed scatter plots of uncertainty in the mean modeled windspeed versus observed windspeed and versus actual claim based damage ratio.

Reviewed loss costs for frame and masonry unknown, fully-engineered, partially-engineered, and minimally-engineered structures for three different year built examples.

Discussed changes in Form V-1 losses due to change in the reference structures and movement of ZIP Code centroids.

Reviewed sample building vulnerability functions for unreinforced and reinforced masonry constructions.

Discussed construction classification for residential single family homes for any height. Discussed future research into classification variation with height.

V-2 Derivation of Contents and Time Element Vulnerability Functions

A. Development of the contents and time element vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) tests, (3) rational structural analysis, and (4) post-event site investigations. Any development of the contents and time element vulnerability functions based on rational structural analysis, post-event site investigations, and tests shall be supported by historical data.

B. The relationship between the modeled building and contents vulnerability functions and historical building and contents losses shall be reasonable.

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

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

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

Audit

1. Modifications to the contents and time element vulnerability component in the model since the previously accepted model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impact on the contents and time element vulnerability component. Comparisons with the previously accepted model will be reviewed.

2. Multiple samples of contents and time element vulnerability functions will be reviewed.

3. To the extent that historical data are used to develop mathematical depictions of contents vulnerability functions, the goodness-of-fit of the data to fitted models will be reviewed.

4. Justification for changes from the previously accepted model in the relativities between vulnerability functions for building and the corresponding vulnerability functions for contents will be reviewed.

5. Justification and documentation for the dependence of contents vulnerability functions on construction and/or occupancy type will be reviewed.

6. Documentation and justification of the following aspects or assumptions related to contents and time element vulnerability functions will be reviewed:
   a. The method of derivation and underlying data,
   b. Validation data specifically applicable to time element vulnerability,
   c. Coding of time element by insurers,
   d. The effects of demand surge on time element for the 2004 and 2005 hurricane seasons,

e. Variability of time element vulnerability by building classification and characteristics,
f. Statewide application of time element coverage,
g. Time element vulnerability for various occupancies,
h. The methods used to estimate the time, including uncertainty, required to repair or replace the property, and
i. The methodology and validation for determining the extent of infrastructure damage and their effect on time element vulnerability.

7. Justification for changes from the previously accepted model in the relativities between vulnerability functions for building and the corresponding vulnerability functions for time element will be reviewed.

8. To the extent that historical data are used to develop mathematical depictions of time element vulnerability functions, the goodness-of-fit of the data to fitted models will be reviewed.

Pre-Visit Letter

23. V-2, Disclosure 3, pages 132-133: Explain the development of Figures 43 and 44 and the changes or lack of changes in these figures relative to Figures 43 and 45 of the previously accepted submission.

Verified: YES

Professional Team Comments:

Reviewed plot of the two base residential and commercial residential content vulnerability functions. Discussed the relationship between the contents vulnerability functions for commercial residential and commercial.

Discussed the Individual Risk Model (IRM) used to compute the impact of individual or combined secondary risk features to the base building vulnerability functions.

Reviewed validation of roof covering, window protection, roof geometry, roof cover attachment, and roof deck attachment using detailed data from 2004-2005 Florida hurricanes.

Reviewed the rationale for the changes in the “simulated” versus “actual” damage ratios in Figures 30-38.

Discussed the model simulation of 100% Coverage D losses for low Coverage A losses in Figure 42 were due to faulty client exposure data.

Reviewed scatter plot of contents damage ratios for all company-event combinations used in validation.

Reviewed and discussed the goodness-of-fit Kolmogorov-Smirnov test results for contents vulnerability.

Discussed no changes to the vulnerability methodology for calculating content and time element losses. Relativities between structure loss and contents loss and between structure loss and time element loss remain unchanged.

Reviewed scatter plots of actual and modeled content damage ratios versus windspeed for frame and masonry construction.

Reviewed comparison of actual and modeled content losses by construction (frame and masonry) and by occupancy (single family and condominiums).

Reviewed an example time element damage function for a residential building.

Reviewed scatter plot of the relationship of time element mean damage ratio to building damage ratio for actual and modeled losses.

Discussed time element coverage is applied consistently throughout Florida.

Reviewed scatter plot of actual and modeled time element damage ratios versus windspeed.

Reviewed and discussed the goodness-of-fit Kolmogorov-Smirnov test results for time element vulnerability.

Discussed the introduction of certified structures secondary risk features for commercial occupancies, including commercial residential condo-units, based on the Insurance Institute for Business & Home Safety (IBHS) Fortified Commercial Program.

Discussed the update to the building technology/structural aging factors.

Discussed the roof age bands update and the application of roof year-built and building year-built to capture the impact of roof aging.

Discussed the implementation of a seal of approval factor to the building modification function. Reviewed the impact of the seal of approval factor on minimally-engineered, partially-engineered, and fully-engineered structures.

Reviewed Figure 41, Relationship of Content Mean Damage Ratio to Building Damage Ratio for Historical Data and Modeled Results, plotted for losses greater than 1% on linear scale.

Discussed the proportion of commercial only and commercial residential for the contents commercial residential vulnerability function.

Reviewed distribution of residential, commercial residential, and commercial for contents replacement values in Florida based on AIR's proprietary Industry Exposure Database.

V-3 Mitigation Measures

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

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

The modeling organization shall justify all mitigation measures considered by the model.

B. Application of mitigation measures that enhance the performance of the building and its contents shall be justified as to the impact on reducing damage whether done individually or in combination.

Audit

1. Modifications to mitigation measures in the model since the previously accepted model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications, and their impacts on the vulnerability component. Comparisons with the previously accepted model will be reviewed.

2. Form V-2, Mitigation Measures, Range of Changes in Damage, and Form V-3, Mitigation Measures, Mean Damage Ratios and Loss Costs (Trade Secret item), will be reviewed.

3. Implementation of individual mitigation measures will be reviewed as well as the effect of individual mitigation measures on damage. Any variation in the change over the range of windspeeds for individual mitigation measures will be reviewed. Historical data, technical literature, analysis or judgment based on fundamental engineering principles used to support the assumptions and implementation of the mitigation measures will be reviewed.

4. Implementation of multiple mitigation measures will be reviewed. The combined effects of these mitigation measures on damage will be reviewed. Any variation in the change over the range of windspeeds for multiple mitigation measures will be reviewed.

5. Mitigation measures used by the model that are not listed as required in this standard will be reviewed for theoretical soundness and reasonability.

Verified: YES

Professional Team Comments:

Discussed the impact of mitigation measures on uncertainty.

Discussed impact of metal roof covering on building vulnerability.

Discussed impact of sliding doors, reinforced sliding doors, single width doors, and unknown exterior doors on building vulnerability.

Reviewed changes to the mitigation measures for secondary water resistance, seal of approval, and roof year built.

Reviewed Trade Secret Form V-3 in detail. Compared changes in loss costs from the previous submission Form V-3.

Reviewed the development of Form V-2 using Form V-3.

Reviewed graphical representation of the vulnerability curves for the reference and the fully mitigated building.

Discussed the use of the AIR Individual Risk Module (IRM) to compute the impact of secondary risk features to the base building vulnerability.

Discussed the effects of any combination of building features on the building damage.

Reviewed table of the mitigation and secondary risk features modifying the base vulnerability functions in the model.

Discussed how the variation of loss costs for condo-unit owners with unit location floor achieved by selection of certain secondary risk features. Discussed potential related research area in the future.

ACTUARIAL STANDARDS – Mike Smith, Leader

A-1 Modeling Input Data and Output Reports

A. Adjustments, edits, inclusions, or deletions to insurance company or other input data used by the modeling organization shall be based upon accepted actuarial, underwriting, and statistical procedures.

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

Audit

1. Quality assurance procedures, including methods to assure accuracy of insurance or other input data, will be reviewed. Compliance with this standard will be readily demonstrated through documented rules and procedures.

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

Pre-Visit Letter

24. A-1.B, page 143: Provide the Touchstone documentation referenced in the response.

25. A-1, Disclosure 5, Table 21, page 148: Explain the default "applies the policy limit before the deductible" and the reference to "see response to Standard A-4.A" for the "Apply Location Terms for Residential Contracts" row.

26. A-1, Disclosure 5, Table 21, page 149: Provide the *Exposure Disaggregation in Touchstone* document referenced in the Notes column, Disaggregation row.

Verified: YES

Professional Team Comments:

Reviewed Touchstone documentation available at www.unicede.com and specifically for the masonry construction codes.

Discussed AIR's understanding of insurance practices for residential policies. Discussed the application of deductible and policy limits for residential, commercial residential, and commercial (non-residential) policies.

Reviewed *Exposure Disaggregation in Touchstone* reference document issued September 2016. Discussed the applicability of exposure disaggregation.

Discussed AIR's Industry Exposure Database and the FHCF aggregated exposure database.

Reviewed Touchstone Financial Module documentation issued January 2016.

A-2 Event Definition

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

Audit

1. The model will be reviewed to evaluate whether the determination of losses in the model is consistent with this standard.

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

3. The model will be reviewed to determine whether the model takes into account any damage resulting directly and solely from flood or hurricane storm surge. Losses associated with wind damage will be reviewed to determine the treatment of flood and hurricane storm surge.

Verified: YES

Professional Team Comments:

Discussed insured wind-related damages associated with storms reaching hurricane strength and producing minimum damaging windspeeds in Florida.

Discussed normalization of wind and surge losses.

Reviewed AIR documentation updated January 2017 for Hurricane Model for the U.S. Version 16.0.0 as implemented in Touchstone 4.1.0: "AIR Interpretation of Standard A-2.A. Directive as it Relates to Florida Statute, Chapter 627.4025, 2.c. – Definition of Hurricane."

Discussed types of events included in the historical hurricane catalog. Discussed how these event criteria would relate to simulated events.

A-3 Coverages

A. The methods used in the calculation of building loss costs shall be actuarially sound.

B. The methods used in the calculation of appurtenant structure loss costs shall be actuarially sound.

C. The methods used in the calculation of contents loss costs shall be actuarially sound.

D. The methods used in the calculation of time element loss costs shall be actuarially sound.

Audit

1. The methods used to produce building, appurtenant structure, contents and time element loss costs will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed loss cost methodology. Discussed no change.

A-4 Modeled Loss Cost and Probable Maximum Loss Considerations

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

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

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

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

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

Audit

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

2. The method of determining probable maximum loss levels will be reviewed.

3. The uncertainty in the probable maximum loss levels and the estimated annual loss costs will be reviewed.

4. The data and methods used to incorporate individual aspects of demand surge on personal and commercial residential losses, inclusive of the effects from building material costs, labor costs, contents costs, and repair time will be reviewed.

5. How the model accounts for economic inflation associated with past insurance experience will be reviewed.

6. How the model accounts for flood and storm surge losses will be reviewed.

7. All referenced literature will be reviewed, in hard copy or electronic form, to determine applicability.

Pre-Visit Letter

27. A-4.C, page 155: Quantify or estimate a range for any non-explicit "provision for direct hurricane storm surge losses."

28. A-4, Disclosure 4, page 157: Provide the white paper "documenting the development of demand surge estimates in the model."

Verified: YES

Professional Team Comments:

Discussed that storm surge runs in the background and that the user can select whether to include storm surge losses in the output. Discussed the storm surge option in the software was not selected for any model runs that generated loss cost results calculated for the submission. Submission updated to specify this information.

Reviewed that use of storm surge is specified in the output report.

Reviewed code for normalization of wind and surge losses methodology.

Reviewed AIR Demand Surge Function white paper revised July 2010.

Discussed how demand surge factors applied to an event may change over time due to changes in economic factors.

Reviewed table of demand surge factors, by coverage, for industry-wide losses.

Reviewed AIRCURRENTS article, "Understanding Uncertainty," by Dr. Jay Guin issued March 2010.

A-5 Policy Conditions

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

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

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

Audit

1. The process used to determine the accuracy of the insurance-to-value criteria in data used to develop and validate the model results will be reviewed.

2. To the extent that insurance claims data are used to develop mathematical depictions of deductibles, policy limits, policy exclusions, and loss settlement provisions, the goodness-of-fit of the data to fitted models will be reviewed.

3. To the extent that insurance claims data are used to validate the model results, the treatment of the effects of deductibles, policy limits, policy exclusions, loss settlement provisions, and coinsurance in the data will be reviewed.

4. Treatment of annual deductibles will be reviewed.

5. Justification for the changes from the previously accepted model in the relativities among corresponding deductible amounts for the same coverage will be reviewed.

Pre-Visit Letter

29. A-5.A, page 158: Explain the “Expected Insured Loss” formula.

Verified: YES

Professional Team Comments:

Reviewed the expected insured loss formula and its application to deductibles and coinsurance.

Discussed deductible relativities.

A-6 Loss Outputs and Logical Relationships to Risk

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

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

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

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

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

F. Loss costs cannot increase as the wind resistant design provisions increase, all other factors held constant.

G. Loss costs cannot increase as building code enforcement increases, all other factors held constant.

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

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

J. Output ranges shall be logical for the type of risk being modeled and apparent deviations shall be justified.

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

1. ***masonry construction versus frame construction,***
2. ***personal residential risk exposure versus manufactured home risk exposure,***
3. ***inland counties versus coastal counties, and***
4. ***northern counties versus southern counties.***

A-6 Loss Outputs and Logical Relationships to Risk (Continued)

L. For loss cost and probable maximum loss level estimates derived from and validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) coinsurance, and (4) contractual provisions shall be appropriate based on the type of risk being modeled.

Audit

1. The data and methods used for probable maximum loss levels for Form A-8, Probable Maximum Loss for Florida, will be reviewed. The hurricane associated with the Top Event will be reviewed.

2. All referenced literature will be reviewed, in hard copy or electronic form, to determine applicability.

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

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

5. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Methods (including any software) used in verifying Standard A-6 will be reviewed. Forms A-1, Zero Deductible Personal Residential Loss Costs by ZIP Code, A-2, Base Hurricane Storm Set Statewide Losses, A-3, 2004 Hurricane Season Losses, A-6, Logical Relationship to Risk (Trade Secret item), and A-7, Percentage Change in Logical Relationship to Risk, will be reviewed to assess coverage relationships.

6. The loss cost relationships among deductible, construction type, policy form, coverage, building code/enforcement, building strength, condo unit floor, number of stories, territory, and region will be reviewed.

7. The total personal and commercial residential insured losses provided in Forms A-2, Base Hurricane Storm Set Statewide Losses and A-3, 2004 Hurricane Season Losses, will be reviewed individually for total personal residential and total commercial residential insured losses.

8. Forms A-4, Output Ranges, and A-5, Percentage Change in Output Ranges, will be reviewed, including geographical representations of the data where applicable.

9. Justification for all changes in loss costs from the previously accepted model will be reviewed.

10. Form A-4, Output Ranges, will be reviewed to ensure appropriate relativities among deductibles, coverages, and construction types.

11. Apparent anomalies in the output ranges and their justification will be reviewed.

Pre-Visit Letter

30. A-6, Disclosure 9, page 165: Provide a reference.

31. A-6, Disclosure 14, page 166: Provide an example illustrating the effects of coinsurance on commercial residential loss costs.

32. Form A-1.A, pages 271-273: Identify ZIP Codes with larger than expected loss costs relative to their more coastal or southerly neighboring ZIP Codes (e.g., southeast corner of Lake Okeechobee) and justify the results.

33. Form A-4, 0% Deductible, page 324: Calhoun County has a low frame renters loss cost value of 0.593. For this same ZIP Code, provide the masonry renters loss cost value.

34. Form A-4, 0% Deductible, page 332: Santa Rosa County has a low loss cost value of frame owners of 0.577. For this same ZIP Code, provide the masonry owners loss cost value.

35. Form A-4, 0% Deductible, page 333: Wakulla County has a low frame condo unit loss cost value of 0.975. For this same ZIP Code, provide the masonry condo unit loss cost value.

36. Form A-4, pages 323-346: Justify why Monroe County is so much higher in loss costs than every other county (two to three times as much) including high hazard counties.

37. Form A-4, 0% Deductible, page 327: Provide details on the computation of the weighted average for commercial residential losses for Hardee County, having commercial residential exposures in two ZIP Codes (as evidenced from data developed from the aggregate residential exposure data in the file “hlpm2012c.exe”).

38. Form A-4, pages 323-346: There are six counties (Columbia, Franklin, Gulf, Hendry, Holmes, and Washington) that appear to have a single ZIP Code populated with all of the county’s commercial residential exposure in the file generated from “hlpm2012c.exe.” Explain the three distinct values for LOW, AVERAGE, and HIGH for each county (both $0 deductible and specified deductibles).

39. Form A-4, 0% Deductible, page 328: Lafayette County has masonry construction in two of its four ZIP Codes (32013 with 1 row, $370,999 total insured value; 32066 with 33 rows, $80,648,944 total insured value). Explain the averaging and weighting scheme used to arrive at the reported masonry value, supplying additional digits as necessary.

40. Form A-4, 0% Deductible, page 328: Consider Lafayette County for manufactured homes. Again two ZIP Codes only contain exposure with one ZIP Code dominating. Explain the averaging and weighting scheme used to arrive at the reported manufactured homes value, supplying additional digits as necessary.

41. Form A-7, Table 57, page 361: Explain the Inland increase in Coverage D for multiple Construction/Policy combinations.

42. Form A-7, Table 58, pages 362-363: Explain the Year Built 2004 increases for multiple Construction/Policy combinations.

43. Form A-7, Table 59, pages 363-364: Explain the Strong decreases for multiple Construction/Policy combinations.

44. Form A-7, Table 60, page 364: Explain the 15th Floor decreases for multiple Construction/ Policy combinations.

45. Form A-8, Tables 63 & 64, page 369: Provide the first and second moments of the Annual Aggregate and Annual Occurrence distributions underlying the tables. Also, provide the first and second moments of the frequency and severity distributions underlying the PMLs shown in Parts B and C.

46. Form A-8, Figure 97, page 370: Provide an expanded graph above $90 billion.

Verified: YES

Professional Team Comments:

Discussed application of coinsurance. Reviewed schematic example of the effects of coinsurance on commercial residential loss costs.

Reviewed color-coded maps of the modeled losses, average friction, maximum winds modeled for the Base Hurricane Storm Set, and modeled 250-year wind return period.

Reviewed the differences in loss cost results for renters frame and renters masonry for Calhoun County, for frame owners and masonry owners for Santa Rosa County, and for frame condo unit and masonry condo unit for Wakulla County.

Reviewed the process for identifying and explaining anomalies in the loss cost results in Form A-4 (Output Ranges).

Reviewed loss costs for Monroe County. Reviewed comparison of Monroe County loss costs to Miami-Dade County loss costs. Details to be discussed with the Commission.

Reviewed color-coded maps of directional friction factors for Monroe and Miami-Dade counties.

Reviewed color-coded maps of the maximum winds for the modeled version of the Base Hurricane Storm Set for actual terrain and the 250-year return period.

Reviewed comparison of the open protection distributions in the FHCF 2012 aggregated exposure data.

Reviewed comparison of the roof shape distributions in the FHCF 2012 aggregated exposure data.

Reviewed map with locations of the minimum and maximum loss costs plotted for Monroe and Miami-Dade counties.

Reviewed comparison of loss cost frequencies in homeowners frame construction for Monroe and Miami-Dade counties.

Discussed the values for low, average, and high output range loss costs for Columbia County.

Discussed the averaging and weighting scheme used to derive Lafayette County masonry and manufactured home loss costs in Form A-4 (Output Ranges).

Discussed the relationship between Coverage A and Coverage D losses.

Discussed the increases for year built 2004 in Form A-7 (Percentage Change in Logical Risk Relationship).

Discussed the decreases for strong building strength in Form A-7 (Percentage Change in Logical Risk Relationship).

Discussed the separate and combined impacts of terrain roughness, adjacent building height, and floor of interest on loss costs for the 3rd, 9th, 15th, and 20th floor levels.

Reviewed the mean, variance, and standard deviation for the annual aggregate loss and the annual occurrence loss in Form A-8 (Probable Maximum Loss for Florida).

Reviewed an expanded graph for Figure 97 above $90 billion.

Reviewed Form A-6 in detail.

Reviewed color-coded contour map of loss costs for strong owners frame buildings in Form A-6.

Reviewed scatter plot of loss costs against distance to closest coast for strong owners frame buildings in Form A-6. Discussed underlying reasons for the outliers.

Discussed loss costs by floor of interest in Form A-6, Condo Unit Floor Sensitivity.

Discussed loss costs by number of stories in Form A-6, Number of Stories Sensitivity.

Reviewed the top 50 events for both the annual aggregate loss and the annual occurrence loss provided in Form A-8.

Discussed Hurricane Andrew (1992) and 2004 hurricane losses provided in Forms A-2 and A-3 compared to industry loss estimates.

COMPUTER/INFORMATION STANDARDS – Paul Fishwick, Leader

CI-1 Documentation

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

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

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

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

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

Audit

1. The primary document repository, in either electronic or physical form, and its maintenance process will be reviewed. The repository should contain or reference full documentation of the software.

2. All documentation should be easily accessible from a central location in order to be reviewed.

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

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

5. Verification that documentation is created separately from, and is maintained consistently with, the source code will be reviewed.

6. The tables specified in CI-1.D that contain the items listed in Standard G-1, Scope of the Model and Its Implementation, Disclosure 5 will be reviewed. The tables should contain the item number in the first column. The remaining five columns should contain specific document or file references for affected components or data relating to the following Computer/Information Standards: CI-2, Requirements, CI-3, Model Architecture and Component Design, CI-4, Implementation, CI-5, Verification, and CI-6, Model Maintenance and Revision.

7. Tracing of the model changes specified in Standard G-1, Scope of the Model and Its Implementation, Disclosure 5 and Audit 5 through all Computer/Information Standards will be reviewed.

Pre-Visit Letter

47. CI-1.B, pages 167-168: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 (pages 28-29) by demonstrating individual table item compliance with Computer/Information Standards CI-1 through CI-7.

51. Appendix 8, page 405: Provide the *Enhancements and Florida Commission Documentation Map* for Standard CI-1 cited by Narges Pourghasemi.

52. Appendix 8, pages 406 & 410: Provide a description of the "update to Individual Risk Module" and "remove intensity reuse" as identified by Narges Pourghasemi on pages 406 (top paragraph) and 410 (first paragraph), and relate to model changes from Standard G-1, Disclosure 5 (pages 28-29).

Verified: YES

Professional Team Comments:

Reviewed the modeler's method and software support for creating and maintaining documentation.

Verified that documentation is easily accessible from the central location for the audit.

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

Reviewed the table required by Standard CI-1.D.

Reviewed the audit schedule followed by Narges Pourghasemi when conducting her review of the model under the Computer/Information Standards.

Reviewed descriptions of "update to Individual Risk Module (IRM)" and "intensity reuse" modification.

CI-2 Requirements

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

Audit

1. Maintenance and documentation of a complete set of requirements for each software component, database, and data file accessed by a component will be reviewed.

Pre-Visit Letter

48. CI-2, page 169: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5 (pages 28-29).

Verified: YES

Professional Team Comments:

Reviewed requirements documentation for each model change identified in Standard G-1, Disclosure 5.

Reviewed reverse geocoding requirements.

CI-3 Model Architecture and Component Design

The modeling organization shall maintain and document (1) detailed control and data flowcharts and interface specifications for each software component, (2) schema definitions for each database and data file, (3) flowcharts illustrating model-related flow of information and its processing by modeling organization personnel or consultants, and (4) system model representations associated with (1)-(3). 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 flowcharts, 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 flowchart including components, sub-component flowcharts, arcs, and labels, and
   e. Flowcharts illustrating model-related information flow among modeling organization personnel or consultants (e.g., BPMN, UML, SysML, or equivalent technique including a modeling organization internal standard).

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

Verified: YES

Professional Team Comments:

Verified the modeler's implementation and use of a flowcharting standard.

Reviewed the workflow process flowchart used for validating ZIP Codes.

Reviewed a flowchart illustrating how changes in the HURDAT2 database are used in the calculation of the hurricane landfall distribution.

Reviewed a flowchart defining the method for processing hurricane characteristics and parameters.

CI-4 Implementation*

*(*Significant Revision)*

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

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

C. All components shall be traceable, through explicit component identification in the model representations (e.g., flowcharts) down to the code level.

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

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

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

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

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

Audit

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

2. The documented coding guidelines, including procedures for ensuring readable identifiers for variables, constants, and components and confirmation that these guidelines are uniformly implemented will be reviewed.

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 will be reviewed for each component, either in a header comment block, source control database, or the documentation:
   a. Component name,
   b. Date created,
   c. Dates modified, modification rationale, and by whom,
   d. Purpose or function of the component,
   e. Input and output parameter definitions.

6. The table of all software components as specified in CI-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 reviewed for sufficiency, consistency, and explanatory quality.

Verified: YES

Professional Team Comments:

Verified that a conditional branching statement error, relating to non-contiguous windspeed values, was found in the previously accepted version of the model (Touchstone Version 3.0.0) in the handling of a secondary risk feature.

Verified that the branching statement error had been corrected in the current model version under review (Touchstone Version 4.1.0).

Reviewed source code relating to the Individual Risk Module (IRM) and “intensity reuse” updates.

Reviewed source code implementing the normalization approach related to storm surge losses.

Discussed the importance of internal modeler agreement on the differences between code enhancement versus error identification.

CI-5 Verification

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

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

4. Fully time-stamped, documented cross-checking procedures and results for verifying equations, including tester identification, will be reviewed. Examples include mathematical calculations versus source code implementation or the use of multiple implementations using different languages.

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

6. The response to Disclosure 1 will be reviewed.

7. Verification approaches used for externally acquired data, software, and models will be reviewed.

Pre-Visit Letter

49. CI-5, pages 194-198: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5 (pages 28-29).

53. Appendix 8, page 410: Provide an example of "loss number testing" and "smoke testing" under Standard CI-5 as cited by Narges Pourghasemi. For smoke testing, identify the most important, or key, functions that were identified to carry out this type of testing.

Verified: YES

Professional Team Comments:

Reviewed a QA enhancement to test for correct branch processing of the now contiguous windspeed values.

Discussed with the modeler a test for lack of similar branch errors occurring elsewhere in the model.

Discussed the corrected process for creating Form M-1 and ensuring consistency with Form A-2 and Form S-1.

Reviewed validation procedure for validating input files related to the incremental impact assessment process.

Verified that there were at least two software verification methods used in determining logical risk covered in Standard M-6.

Verified that the modeler automates a logical relationship to risk test for Form A-4.

Reviewed the tests of the hurricane parameters for the update to the historical storm catalog.

Reviewed the modeler's approach to loss testing and smoke testing.

Discussed no new data sources were acquired.

CI-6 Model Maintenance and Revision

A. The modeling organization shall maintain a clearly written policy for model review, maintenance, and 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 or probable maximum loss level shall result in a new model version identification.

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

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

Audit

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

2. The policy for model revision and management will be reviewed.

3. Portions of the code, not necessarily related to recent changes in the model, will be reviewed.

4. The tracking software will be reviewed and checked for the ability to track date and time.

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

Pre-Visit Letter

50. CI-6.D, page 202: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Verified that the policy for model revision and management has not changed from the modeler's previously accepted model.

Reviewed the model version history over the past five years, leading up to the version identified in the submission.

CI-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified that there were no security breaches since the modeler's previously accepted model.

Verified improved security measures taken by the modeler.