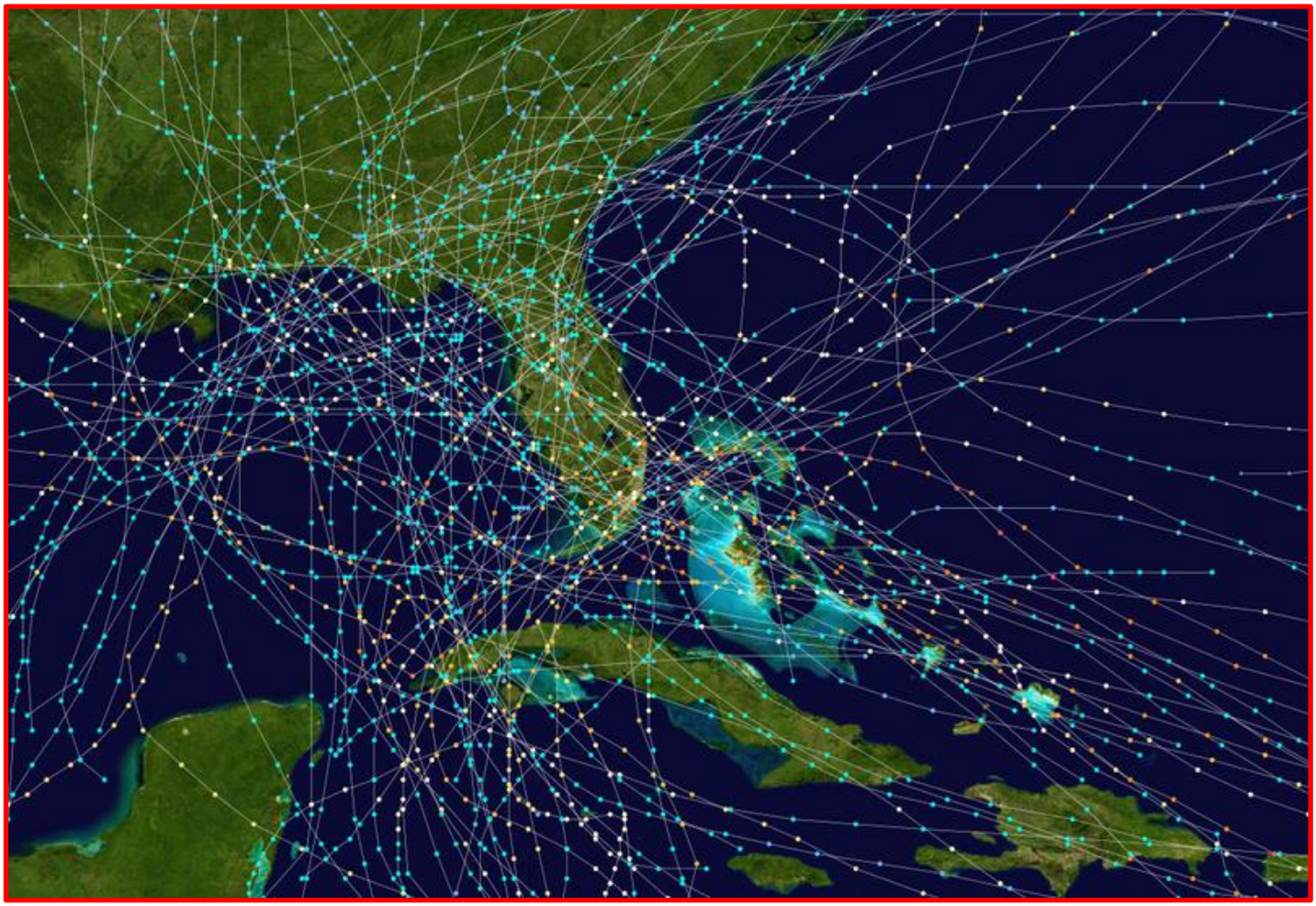
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2013 Standards



Risk Management Solutions, Inc.

On-Site Review
March 16-18, 2015

On March 16-18, 2015, the Professional Team visited on-site at Risk Management Solutions, Inc. (RMS) in Newark, California. The following individuals participated in the review:

RMS
Enrica Bellone, Ph.D., Senior Director, Model Development
Sagar Bora, Modeler, Model Development
Kay Cleary, FCAS, MAAA, FCA, Actuary & Director
Peter Datin, Ph.D., Lead Modeler
Michael Drayton, Ph.D., Consultant
Jara Imbers, Senior Modeler, Model Development
Jo Kaczmarksha, Senior Modeler, Model Development
Kevin Van Leer, Product Manager, Model Product Management
Christina Machak, Senior Analyst Model Development
Joss Matthewman, Ph.D., Principal Catastrophe Risk Modeler
Charles Menun, Ph.D., P.E., Consultant, President Menun Risk Consulting Services, Inc.
Matthew Nielsen, Senior Director, Global Government and Regulatory Affairs
Jacqueline Noto, Model Product Management
Mohsen Rahnama, Ph.D., Senior Vice President, Head of Model Development
Christina Robertson, Modeler, Model Development
Steve Rushton, Senior Director Software Development
Lucas Saloumi, Modeler
Chris Sams, Lead Geospatial Modeler, Geospatial Development
Emilie Scherer, Ph.D., Principal Modeler
Beth Stamann, Senior Documentation Specialist
Derek Stedman, Modeler
Avinash Takale, Principle Software Engineer
Joel Taylor, CCRA, Manager Model Product Management
Yogesh Vani, Senior Manager Software
Rajkiran Vojjala, Director, Model Development
Paul Wilson, Vice President, Model Development
Wenwen Ying, Analyst, Model Product Management
Michael Young, M.E.Sc., P.E., Senior Director Model Product Management

Professional Team
Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Chris Jones, P.E., Coastal Engineer, Observer
Chris Nachtsheim, Ph.D., Statistician, Observer
Michael Smith, FCAS, MAAA, Actuary, Observer
Zhida Song-James, Ph.D., Hydrologist, Observer
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process by the Professional Team. RMS provided an explanation of the errors in the submission and forms identified in the

January 7, 2015 letter to the Commission. Reviewed revised procedures implemented to prevent the errors in form generation from reoccurring.

- S-5 Disclosure 1 – corrected Predicted Loss and Ratios in Table 13, Client Loss Comparisons, the November 2014 submission included losses from additional lines of business in the Predicted Loss
- Form A-2 – divided by an incorrect number of years in the historical event rates
- Form S-5 – divided by an incorrect number of years in the historical event rates
- Form A-7 – incorrect county assignment for one location resulted in reassigning those losses from the original assigned inland county to a coastal county
- Form A-8 – incorrectly included an historical event that was removed from the stochastic catalog due to HURDAT2 reanalysis

The audit continued with RMS providing an overview on the following significant changes in the model:

- Updates to the geocoding module to include February 2014 postal code vintage data
- New proprietary geocoding engine that replaced a third party engine
- Stochastic event set updated to the November 2013 version of HURDAT2
- Historical footprints for 14 events revised from the HURDAT2 1931-1945 re-analysis
- Updates to the surface roughness data
- New year band for post 2008 buildings
- Introduction of North Florida vulnerability regions
- Extended coastal vulnerability regions
- Revised relativity of high square footage single family dwellings
- Updated the opening protection secondary modifiers
- Introduced secondary modifiers that vary with year built

RMS informed the Professional Team of two errors in the previous submission (RiskLink 13.0):

(1) Rmax cumulative distribution function (CDF) plot in Figure 38 under Standard S-1 Disclosure 6 was incorrect due to an error in the values for four storms, and
(2) Form V-2 and Form V-3 used the incorrect population centroid ZIP Code.

Corrected Forms V-2 and V-3 and a corrected Figure 38 and *p*-value percentages were reviewed on-site. RMS will submit corrected Form V-2 and corrected Figure 38 and *p*-value percentages for the Rmax CDF with a letter of explanation to the Commission in accordance with the Acceptability Process.

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

1. Method for completion of Form A-6
2. Method for completion of Form V-3
3. Method for excluding storm surge losses from the modeled losses
4. Method for updating land-use land-cover (LULC) with example for Flagler County
5. Method for coastline smoothing
6. Updates to the vulnerability model including the rationale for coastal/inland vulnerability regions.

The Professional Team reviewed the following corrections to be included in the revised submission which is to be provided to the Commission no later than 10 days prior to the meetings for reviewing models for acceptability. Page numbers correspond to the January 7, 2015 submission.

- Page 20, G-1 Disclosure 2 – revised to clarify Hall and Jewson references
- Page 36, G-1 Disclosure 5 – revised to add information on appurtenant structures
- Page 77, M-4 Disclosure 7 – revised to correct number of years for satellite imagery
- Page 121, V-1 Disclosure 7 – Table 16 revised for square footage unknown
- Page 122, V-1 Disclosure 12 – revised to address square footage unknown
- Page 127, V-2 Disclosure 3 – revised for clarity
- Page 132, V-3 Disclosure 1 – revised to add information on appurtenant structures
- Page 162, C-4 Disclosure 1 – revised to remove operating systems no longer supported
- Page 231, Form V-2 – revised to use the population centroid ZIP Code provided in the form instructions
- Page 343, Form A-8 – revised caption for Table 56 to correct year of FHCF exposure data

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the December 16, 2014 meeting. The deficiencies were eliminated by the established time frame, and the modifications have been verified.

1. Acronym DLM (e.g., page 138) is not defined; non-responsive to the Acceptability Process II.A.5.l requirement (page 48) in the *Report of Activities*.

2. Standard G-1, Disclosure 5.A (page 36)
   Response is incomplete as no response is included for Disclosure 5.A.2.

3. Standard G-2, Disclosure 3.B (page 54)
   Response is non-responsive as independent peer reviews do not address the current standards, disclosures, or forms.

4. Form M-1.E (page 182)
   Response is non-responsive as all hurricanes modified are not included.

5. Standard V-2, Disclosure 14 (page 130)
   Response is unclear as the cited Table 44 does not address contents and time element vulnerability function relationships consistency with insurance claims data.

Report on Issues

The Professional Team discussed the following issues identified by the Commission at the December 16, 2014 meeting. The modeler is to address these issues with the Commission during the meeting to review the model for acceptability.

1. How Florida Building Code enforcement of reinforced and unreinforced masonry is handled in the model. What is the default condition in the model post 2002? If the data is available, does the model take this into account, and if so, how?

2. How screen enclosures for both attached and unattached are handled in the model.

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

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

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

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

review should be available on-site for the Professional Team. The Professional Team should be provided access to internet connections through the Professional Team members' laptops for reference work that may be required while on-site.

The on-site schedule is tentatively planned to proceed in the following sequence: (1) presentation by the modeler of new or extensively updated material related to the model; (2) section by section review commencing within each section with pre-visit letter responses; (3) responses to new or significantly changed standards in the 2013 Report of Activities, and (4) responses to the audit items for each standard in the Report of Activities.

Be prepared to have available for the Professional Team's consideration, all insurance company claims data received or newly processed since the previous submission. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

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

When the Professional Team arrives on-site, provide five (5) printed copies of all figures with scales for the X and Y axes labeled that are not so labeled in the submission. Label the figures with the same figure number as given in the submission. Also, provide five (5) printed copies of Form V-3 and the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete. Additionally, provide five (5) printed copies of Form A-6 (all 8 worksheets) and the electronic file(s) used to complete Form A-6 and Form A-7. The electronic files will be examined only on-site and will be deleted from the Professional Team member's laptop at the conclusion of the review.

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

If any changes have been made in any part of the model or the modeling process from the descriptions provided in the original 2013 submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and all revised Forms where any output of the form changed.

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

The pre-visit comments are grouped by standards sections.

GENERAL STANDARDS – Mark Johnson, Leader

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

*(*Significant Revision)*

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

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

Audit

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

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

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

4. Modeling organization specific publications cited must be available in hard or soft copy or via a web link.

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

6. Provide the following information related to changes in the model from the initial submission this year to each subsequent revision.

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

B. Percentage difference in average annual zero deductible statewide loss costs based on the 2007 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named *"hlpm2007c.exe"* for:
   1. All changes combined, and
   2. Each individual model component and subcomponent change.

C. For any modifications to Form A-4A (Output Ranges, 2007 FHCF Exposure Data) since the initial submission, additional versions of Form A-5 (Percentage Change in Output Ranges, 2007 FHCF Exposure Data):
   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 2007 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named *"hlpm2007c.exe"* for each model component change:
   1. Between the previously accepted submission and the revised submission,
   2. Between the initial submission and the revised submission, and
   3. Between any intermediate revisions and the revised submission.

Pre-Visit Letter

1. G-1, Disclosure 2, page 20: Specify if the two references to Hall & Jewson 2007 are 2007a or 2007b.

2. G-1, Disclosure 5.C, page 40: Explain the situation with the adjacent Volusia and Flagler Counties in Figure 6.

Verified: YES

Professional Team Comments:

Discussed Hall and Jewson (2007) reference on page 20 is actually two references: Hall and Jewson (2007a) and Hall and Jewson (2007b). Response under G-1 Disclosure 2 was revised.

Discussed the changes in loss costs in Volusia and Flagler Counties being driven by the hazard updates in the model as well as counties on the north-south boundary. Discussed that changes in loss costs in Flagler County also impacted by LULC changes.

G-2 Qualifications of Modeling Organization Personnel and Consultants

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

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

Audit

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

2. Forms G-1 (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 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. Discuss any incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

3. G-2, Disclosure 2.B, page 51: Provide resumes of new personnel.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Irina Behnert, Ph.D. Physics, University of Bucharest, Romania and Technische Universität, Berlin, Germany; M.S. History, University of Pantheon-Sorbonne, Paris, France; B.A. Engineering Physics, University of Bucharest, Romania
- Masha Bilyak, B.S. Economics and Management, Polytechnic University, Lvov, Ukraine

- Sagar Bora, Ph.D. candidate Physics, Alfred Wegener Institute, Bremerhaven, Germany; M.S. Environmental Physics, University of Bremen, Bremen, Germany; B.S. Physics, Jacobs University, Bremen
- Jason Bryngelson, M.S. Structural Engineering, San Jose State University, San Jose, CA; B.S. Civil Engineering, San Jose State University, San Jose
- Umesh Chander, M.S. Computer Science, Northwestern Polytechnic University, Fremont, CA; PGDBM (Post Graduate Diploma in Business Management) Systems/Computers, Institute of Management Technology, Ghaziabad, Uttar Pradesh, India; Diploma in Business Management, Institute of Management Technology, Ghaziabad; BCA (Bachelor in Computer Application), Indira Gandhi National Open University, New Delhi, India
- Ching-Yee Chang, Ph.D. Chemical Physics specialized in Atmospheric and Oceanic Sciences, University of Maryland, College Park, MD; M.S. Physics, University of Massachusetts, Amherst, MA; M.S. Physics, National Tsing Hua University, Hsinchu, Taiwan; B.S. Physics, National Taiwan University, Taipei, Taiwan
- Chethana Chidambara, B.E. Computer Science, Bangalore University, Bengaluru, India
- Karen Clarke, B.S. Biomedical Engineering, University of Iowa, Iowa City, IA
- Cynthia Dai, M.S. Computer Engineering, University of California, Santa Cruz, CA; M.S. Geophysics, Institute of Geophysics, Chinese Academy of Sciences, Beijing, China
- Peter Datin, Ph.D. Civil Engineering, University of Florida, Gainesville, FL; M.S. Civil Engineering, Clemson University, Clemson, SC; B.S. Civil Engineering, Oklahoma State University, Stillwater, OK
- Sushil Dhyani, MCA (Master of Computer Application), Maharishi Dayanand University, Rohtak, India; M.S.C. Maharishi Dayanand University, Rohatk, India;
- Laura Eads, Ph.D. Civil and Environmental Engineering, Stanford University, Stanford, CA; M.S. Civil and Environmental Engineering, Stanford University, Stanford, CA; B.S. Civil Engineering, University of Notre Dame, Notre Dame, IN
- David Gatey, Ph.D. candidate Civil and Environmental Engineering, University of Western Ontario, London, Ontario, Canada; B.E.Sc. Civil and Environmental Engineering, University of Western Ontario, London, Ontario
- JKara Imbers Quintana, Ph.D. Physics, University of Nottingham, Nottingham, UK; M.Phys Theoretical Physics, University of Kent, Canterbury, UK
- Jo Kaczmarska, Ph.D. Statistical Science, University College of London, Camden, England; M.S. Statistical Science; B.S. Mathematics with Statistics, Bristol University, Bristol, England
- Gunalan Sathish Kumar, M.Tech, Remote Sensing, Anna University, Chennai, T.N., India; B.E. Civil Engineering, Madras University, Chennai, T.N., India
- Jenny Lu, M.S. Computer Science, Wuhan University, Wuhan, China; B.S. Computer Science, Beijing University, Beijing, China
- Rakesh Mohindra, Ph.D. Historical Geomorphology, Neotectonic, Sedimentology and Remote Sensing, University of Roorkee, Roorkee, India; M. Tech. Applied Geology, University of Roorkee, Roorkee, India
- Gilbert Molas, Ph.D. Civil Engineering, University of Tokyo, Tokyo, Japan; M.Eng. Civil Engineering, University of Tokyo, Tokyo, Japan; B.S. Civil Engineering, University of the Philippines

- Christina Robertson, M.S. Atmosphere Ocean and Climate, University of Reading, Reading, England; B.S. Physics with Meteorology, University of Edinburgh, Edinburgh, Scotland
- Steve Rushton, M. Arch. CAD, University of California, Berkeley, CA; M.A. Visual Design/Photography, University of California, Berkeley, CA; B.S. Mathematics and Computer Science, University of Illinois, Urbana-Champaign, IL
- Lucas Saloumi, M.S. Earth and Environmental Engineering, Columbia University, New York, NY; B.S. Electrical and Computer Engineering, Supélec, Ecole Supérieure d'Electricité, Paris, France
- Richa Sharma, B.Tech. Information Technology, Mahatma Gandhi Mission's College of Engineering & Technology, Noida, affiliated to Uttar Pradesh Technical University, Lucknow, India
- Jason Smith, Ph.D. Civil Engineering, University of Florida, Gainesville, FL; B.S. Civil Engineering, The Citadel, Charleston, SC
- Derek Stedman, M.S. Civil and Environmental Engineering, University of Western Ontario, London, Ontario, Canada; B.S. Civil Structural Engineering, University of Western Ontario, London, Ontario, Canada
- Srinivas Thupakula, B.Tech. Civil Engineering, Indian Institute of Technology, Kanpur, India
- Kevin Van Leer, M.S. candidate Atmospheric Science, University of Illinois, Urbana-Champaign, IL; B.S. Atmospheric Science, Purdue University, West Lafayette, IN
- Rajkiran Vojjala, M.S. Civil Engineering, Stanford University, Stanford, CA; B.E. Structural Engineering, Visvesvaraya National Institute of Technology, Nagpur, India
- Paul Wilson, Ph.D. Atmospheric Physics, Imperial College London, London, England; M.S. Physics, Imperial College London, London, England
- Wenwen Ying, B.S. Statistics and Actuarial/Finance Mathematics, University of Michigan, Ann Arbor, MI; B.S. Statistics, Zhejiang University, Hangzhou, China

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

G-3 Risk Location*

*(*Significant Revision)*

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 consistent and justifiable.

Audit

1. Provide geographic displays for all ZIP Codes.
2. Provide geographic comparisons of previous to current locations of ZIP Code centroids.
3. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.
4. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.
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

4. G-3.C, page 56: Provide maps of previous and current ZIP Code centroid locations (as has been done in previous reviews).
5. G-3, Disclosure 5, page 58: Describe the process for updating the model ZIP Code-based databases.

Verified: YES

Professional Team Comments:

Discussed the ZIP Code database update as of February 2014.

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

Reviewed the methodology and process for converting street level addresses to latitude and longitude locations and for converting latitude and longitude locations to ZIP Code. Reviewed table and examples of geocoding for complete and incomplete street addresses.

Reviewed ZIP Code dependent databases and methodology to update them.

Discussed the new proprietary geocoding engine that has replaced the previous third party engine.

Reviewed map of average annual loss changes by county due to the geocoding update. Discussed minimal changes from previous submission.

G-4 Independence of Model Components

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

Audit

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

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

Verified: YES

Professional Team Comments:

There was no evidence to suggest that one component of the model was artificially 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 Certification that the submission has been personally reviewed and is editorially correct.

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2013*.

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

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

4. Demonstrate that the submission has been reviewed by the signatories on Forms G-1 through G-6 (Standards Expert Certification forms) for accuracy and completeness.

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

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

7. Form G-7 (Editorial 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.

Reviewed the flowcharts defining the processes for completing the Forms A-2, A-4A, A-4B, A-7, A-8, and S-5.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT2 starting at 1900 as of August 15, 2013 (or later). Complete additional season increments based on updates to HURDAT2 approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

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

Audit

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

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

3. Changes to the modeling organization Base Hurricane Storm Set from the previously accepted submission 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 and long-term variations in annual hurricane frequencies incorporated in the model will be reviewed.

5. Modeled probabilities will be compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical 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 historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

Pre-Visit Letter

6. Form M-1.E, page 182: Describe how changes in HURDAT2 due to the re-analyses and additions of new hurricane seasons are incorporated into the Base Hurricane Storm Set. Individual cases may be reviewed.

Verified: YES

Professional Team Comments:

Reviewed updates to the historical catalog based on HURDAT2 as of November 2013, including the reanalysis through 1945. Reviewed the list of historical storms added, removed, and modified.

Reviewed comparisons of storm track and intensity changes at landfall due to reanalysis of HURDAT2.

Discussed selection of central pressure observations at landfall. Discussed how these are used in developing the stochastic central pressure distribution. Discussed consistent treatment of historical and stochastic storms with regard to central pressure.

Discussed the methodology for smoothing HURDAT2 frequencies and updating stochastic event rates.

Reviewed color-coded map by county of loss cost changes due to the changes to the historical storm set.

Reviewed table of ground up loss percentage changes due to the hazard updates.

M-2 Hurricane Parameters and Characteristics

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

Audit

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

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

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

4. Scientific literature cited in Standard G-1 (Scope of the Computer 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. Describe and justify the value(s) of the far-field pressure used in the model.

Pre-Visit Letter

7. M-2, Disclosure 3, page 65: Discuss how far field pressure is selected in the model.

Verified: YES

Professional Team Comments:

Discussed no changes in the far-field pressure methodology used in the model.

Reviewed updated fits for parameters noted in the submission.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

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

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

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

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

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

Pre-Visit Letter

8. M-3, Disclosure 1, page 72: Provide all assumptions made.

Verified: YES

Professional Team Comments:

Discussed that hurricane characteristic assumptions are provided in Form S-3.

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 database shall be consistent with National Land Cover Database (NLCD) 2006 or later. Use of alternate data sets 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. Provide any modeling organization-specific research performed to develop the windfield functions used in the model. Identify the databases used.

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

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

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

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

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

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

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

Pre-Visit Letter

9. M-4.B, page 73: The method for updating the LULC dataset used to define the roughness coefficients used in the model will be reviewed. Specific examples of regions evaluated and changes made will be examined.

10. M-4, Disclosure 9, page 77: Explain why Figures 16-21 and Figures 23-24 are unchanged from the previous submission although the roughness model has been updated (Disclosure 8) for revised roughness coefficients consistent with updates to LULC (Disclosure 7).

11. M-4, Disclosure 10, page 81: The method for updating the historical windfield footprints will be examined. Updates to Hurricane NoName09 from 1945 (AL091945) will be compared with the same hurricane as presented in the previous submission.

12. M-4, Disclosure 11, page 81: Discuss the rationale for the different treatment of roughness factors between historical and stochastic storms. Specific examples of historical storm footprints calculated with each of the roughness databases will be examined.

13. Form M-2, pages 193-199: Discuss the relative variation of the windspeed minima versus maxima between the three temporal sampling periods.

Verified: YES

Professional Team Comments:

Reviewed update to the land-use and land-cover (LULC) data to be consistent with the National Land Cover Database (NLCD) 2006 vintage. Discussed what was meant by consistent. Reviewed flowchart on the method for the LULC update.

Reviewed chart of LULC category classification changes tracked between the NLCD2001 and NLCD2006 databases. Changes between categories were identified for updating in the model LULC database.

Reviewed examples comparing geographic changes in the NLCD2001 to NLCD2006 data.

Reviewed Florida map identifying potential LULC change locations.

Reviewed color-coded maps by county of loss cost percentage changes due to the LULC update.

Reviewed maps of Variable Resolution Grid (VRG) site coefficients percentage changes across Florida.

Reviewed the roughness coefficient detail in the LULC update for a specific VRG grid in Alachua County.

Reviewed geographic comparisons of the roughness lengths and site coefficient changes from the previous submission.

Discussed Figures 16-21 and 23-24 showing footprints and corresponding observations for historical storms which use the same LULC from the NLCD2001 in the previous submission.

Discussed the relative variation of the windspeed maxima and minima in Form M-2.

Discussed the rationale for the different treatment of roughness factors between historical and stochastic storms.

Reviewed historical windspeed footprint comparisons of the previous LULC roughness coefficients to the new LULC roughness coefficients for Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).

Reviewed updates in the historical catalog for LaborDay03 (1935) and NoName09 (1945) hurricanes.

Reviewed flowcharts for developing historical storm wind footprints pre-1944 in the absence of regular time series of observations and 1944 onward from HURDAT2.

Discussed multiple data sources used in developing and validating wind footprints.

The Professional Team recommends the modeler present their process for LULC updates (Flagler County example) during the Trade Secret session.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

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

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

Audit

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

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

3. 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. Provide 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.

Pre-Visit Letter

14. M-5, Disclosure 3, page 86: Explain why Figure 25 is unchanged from the previous submission although the roughness factors have changed based on updates to the LULC database.

Verified: YES

Professional Team Comments:

Reviewed comparison of Figure 25, Roughness Coefficient as a Function of Distance to Coast, ZIP Code points from the previous submission to the current submission.

Observed that provision is made for storms landfalling outside of Florida to cause wind damage in Florida.

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 provide the information used in auditing this standard.

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

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

Pre-Visit Letter

15. M-6, Disclosure 3, page 88: Comparisons between the modeled Rmax distribution and the historical radii data used to validate it will be reviewed.

Verified: YES

Professional Team Comments:

Discussed methodology for deriving modeled Rmax from historical values in Extended Best Tracks. Discussed no change in the methodology from the previous submission.

Discussed method for validating threshold wind radii for historical storms.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

B. Modeled and historical results shall reflect 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-2A (Examples of Loss Exceedance Estimates, 2007 FHCF Exposure Data), S-2B (Examples of Loss Exceedance Estimates, 2012 FHCF Exposure Data), and S-3 (Distributions of Stochastic Hurricane Parameters) will be reviewed. Provide justification for the distributions selected including, for example, citations to published literature or analyses of specific historical data.

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

Pre-Visit Letter

16. S-1, Disclosure 3, page 93: Describe how the additional data from Hurricane Dennis (2005), Hurricane Katrina (2005), Hurricane Rita (2005), Hurricane Irene (2011), Hurricane Isaac (2012), and Hurricane Sandy (2012) have been used to validate and verify the model.

17. S-1, Disclosure 6, pages 97-101: Explain the large change in *p*-values for two years of additional data in Figure 30 as well as other changes in *p*-value for Figures 32, 33, and 34.

Verified: YES

Professional Team Comments:

Discussed claims data from Hurricane Dennis (2005). Discussed the quality controlled claims data from Hurricane Ivan (2004). Discussed claims data from Hurricane Katrina (2005), Hurricane Rita (2005), Hurricane Irene (2011), Hurricane Isaac (2012), and Hurricane Sandy (2012) were used for validation of the model in other states.

Discussed the change in central pressure distribution *p*-values from the previous submission due to storms NoName10 (1926), NoName05 (1933) and Hurricane Katrina (2005) added and storms NoName03 (1911) and Hurricane Ethel (1960) removed.

Discussed goodness-of-fit test results for central pressure, forward speed, and Rmax. Reviewed graphical comparisons of the cumulative distribution function (CDF) changes from the previous submission due to HURDAT2 reanalysis, changes in long term landfall rates, and the addition of by-pass gates.

Reviewed comparisons and scatter plots of stochastic and observed central pressure and forward speed distribution changes from the previous submission.

Reviewed in detail metrics for the Kolmogorov-Smirnov test on the CDF for central pressure. Discussed rationale for changes in *p*-values from previous submission.

RMS informed the Professional Team that the previous submission Rmax CDF plot in Figure 38 under Standard S-1 Disclosure 6 was incorrect due to an error in the values for four storms. Reviewed a corrected figure and *p*-value percentages. RMS will submit a corrected Figure 38 and *p*-value percentages for the previous submission with a letter of explanation to the Commission.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no changes in model methodology from the previous submission and 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 have taken appropriate action. The analysis shall identify and quantify the extent that input variables impact the uncertainty in model output as the input variables are simultaneously varied.

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no changes in model methodology from the previous submission and 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. Provide a graph assessing the accuracy associated with a low impact area such as Nassau County. We would expect that if the contribution error in an area such as Nassau County is small, the error in the other areas would be small as well. Assess where appropriate, the contribution of simulation uncertainty via confidence intervals.

Pre-Visit Letter

18. S-4, page 106: Provide details on the loss convergence testing as has been done in previous on-site visits.

Verified: YES

Professional Team Comments:

Discussed the use of over 20,000 stochastic events in calculating average annual loss thresholds to ensure convergence by county.

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 experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail and shall include loss data from both 2004 and 2005.

Audit

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

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

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

4. Form S-4 (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

19. S-5, Disclosure 1, pages 108-109: Explain the updates to the RMS Estimates in Table 12 and the predicted losses in Table 13.

Verified: YES

Professional Team Comments:

Reviewed table of industry loss comparisons for Hurricane Andrew (1992), Hurricane Erin (1995), Hurricane Opal (1995), Hurricane Georges (1998), Hurricane Charley (2004), Hurricane Ivan (2004), Hurricanes Frances and Jeanne (2004), Hurricane Wilma (2005), Hurricane Katrina (2005), and Hurricane Dennis (2005). Discussed differences from the previous submission due to changes in the underlying industry exposure data and current model changes.

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 Computer Model and Its Implementation), Disclosure 5.

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

Verified: YES

Professional Team Comments:

Reviewed revised Form S-5.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

A. Development of the building vulnerability functions shall be based on at least one of the following: (1) historical data, (2) tests, (3) rational structural analysis, and (4) site inspections. Any development of the building vulnerability functions based on rational structural analysis, site inspections, and tests shall be supported by historical data.

B. The method of 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 properties.

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, mobile 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 shall be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. For historical data used to develop building vulnerability functions, demonstrate the goodness-of-fit of the data. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete

rational structural analyses shall be presented so that a variety of different building types and construction characteristics may be selected for review. Tests and original site inspection reports shall be available for review.

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

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

5. Justify the construction types and characteristics used.

6. Provide validation of the mean building vulnerability functions and associated uncertainties.

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

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

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

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

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

Pre-Visit Letter

20. V-1, Disclosure 15, page 123: Discuss the relationship between MDR and peak gust by company in Figure 40.

21. Form V-1, pages 219-221: Compare the results in Form V-1 with the previous submission.

Verified: YES

Professional Team Comments:

Discussed the vulnerability updates based on additional claims data received for Hurricane Dennis (2005) and Hurricane Wilma (2005), and final closed claims data from a client for Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Jeanne (2004), and Hurricane Ivan (2004).

Reviewed the new northern vulnerability region implemented after analysis of Hurricane Ivan (2004) claims data excluding storm surge losses. Reviewed histogram of Central Florida claims data from Hurricane Charley (2004), Hurricane Frances (2004) and Hurricane Jeanne (2004) to North Florida claims data from Hurricane Ivan (2004) outside the storm surge footprint.

Reviewed coastal regions redefined to have a smoother coastline. Reviewed selected geographic map comparisons of the coastline changes.

Reviewed claims comparisons for Hurricane Wilma (2005), Hurricane Charley (2004), Hurricanes Frances and Hurricane Jeanne (2004), and Hurricane Ivan (2004) by construction type and by windspeed reflecting the new smoother coastline update.

Reviewed comparisons of the vulnerability functions for the new vulnerability regions in North Florida and Central Florida for wood and masonry.

Reviewed scatter plot comparing modeled versus actual claims data for Hurricane Andrew (1992) for pre-1995 masonry single family dwellings for the inland South Florida region.

Reviewed table of modeled-to-incurred loss ratios for single family dwelling by region using 2004 and 2005 claims data.

Discussed no changes to the mobile home vulnerability functions. Discussed the number and classification options for the mobile home vulnerability functions.

Discussed the new 2009 year built age band introduced based on Florida Building Code changes. Discussed roof deterioration with age of building based on Institute for Building and Home Safety (IBHS) (2007), IBHS (2012), and Masters et al. (2013).

Reviewed new year band vulnerability function comparisons for wood and masonry for post-2002, 2002-2008, and post-2008 year bands.

Reviewed comparisons between masonry and mobile homes for two year bands.

Discussed the revised credits for large square footage floor area for single family dwellings based on the reanalysis of claims data. Reviewed graph of vulnerability relativity by single family dwelling floor area for wood and masonry constructions. Reviewed graphs of the underlying claims count and claim losses by windspeed bands. Reviewed vulnerability relativities by single family dwelling floor area for wood frame.

Discussed no change in the square footage floor area bands from the previous submission. Reviewed bar graph of vulnerability relativity by floor area for single family dwelling. Reviewed table of modeled-to-claim loss ratios for single family dwelling by square footage floor area using claims data.

The Professional Team recommends the vulnerability model updates be presented to the Commission during the Trade Secret session.

Discussed the rationale for the six vulnerability regions.

Discussed ASCE 7 history of design requirements for Exposure B (suburban) and Exposure D (coastal). Discussed ASCE 7 wind borne debris region classification.

Reviewed internal documentation prepared on changes in the wind provisions of building codes in hurricane states.

The Professional Team recommends the method for coastline smoothing and the rationale for coastal/inland vulnerability regions be presented to the Commission during the Trade Secret session.

Discussed the relationship between Mean Damage Ratio (MDR) and peak gust for appurtenant structure claims in Figure 40. Reviewed scatter plots for two different companies of appurtenant structure claims versus modeled losses.

Discussed the changes in Form V-1 from the previous submission.

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

*(*Significant Revision)*

A. Development of the contents and time element vulnerability functions shall be based on at least one of the following: (1) historical data, (2) tests, (3) rational structural analysis, and (4) site inspections. Any development of the contents and time element vulnerability functions based on rational structural analysis, site inspections, 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. To the extent that historical data are used to develop mathematical depictions of contents vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models.

3. Justify changes from the previously accepted submission in the relativities between vulnerability functions for building and the corresponding vulnerability functions for contents.

4. Documentation and justification of the following will be reviewed:
   a. The method of derivation and data on which the time element vulnerability functions are based;
   b. Validation data specifically applicable to time element coverages;
   c. Assumptions regarding the coding of time element losses by insurers;
   d. The effects of demand surge on time element for the 2004 and 2005 hurricane seasons;
   e. Assumptions regarding the variability of time element losses by size of property;
   f. Statewide application of time element coverage assumptions;
   g. Assumptions regarding time element coverage for mobile homes, tenants, and condo unit

owners exposure;

h. The methods used to incorporate the estimated time required to repair or replace the property;
i. The methodology and available validation for determining the extent of infrastructure damage and its effect on time element costs.

5. Justify changes from the previously accepted submission in the relativities between vulnerability functions for building and the corresponding vulnerability functions for time element.

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

Verified: YES

Professional Team Comments:

Discussed no change in the contents damage to building damage relationship.

Discussed no change in the time element loss to building damage relationship.

Discussed the impact of updates in building vulnerability on contents vulnerability functions.

Discussed the impact of updates in building vulnerability on time element loss functions.

V-3 Mitigation Measures*

*(*Significant Revision)*

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

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) provide the information used in auditing this standard.

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

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

Pre-Visit Letter

22. Form V-2, pages 222-223: Compare the results in Form V-2 with the previous submission.

Verified: YES

Professional Team Comments:

Reviewed the results provided in Form V-2. Discussed differences from the previous submission due to Mean Damage Ratio (MDR) capping at 100% for the reference vulnerability curve. An error was discovered in completing Forms V-2 and V-3. Corrected forms were prepared during the audit and reviewed. Confirmed consistency between the revised Form V-2 and revised Form V-3.

RMS informed the Professional Team that the same error in completing Forms V-2 and V-3 was made in the previous submission. Reviewed corrected Forms V-2 and V-3 for RiskLink 13.0. RMS will submit a corrected Form V-2 for the previous RiskLink 13.0 submission with a letter of explanation to the Commission.

Discussed the analysis of new exposure data containing secondary modifiers information. Reviewed bar graphs of the percentage exposure data by value for opening protection, roof compliance, and roof deck attachment by region in the new exposure data.

Discussed the new opening protection secondary modifier options including new options for garage and sliding glass doors. Reviewed table of changes to the secondary modifier options from the previous submission.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeling Input Data

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed processes in completion of the actuarial forms and the need for greater technical review before submission to the Commission.

Discussed improvements in the quality of recent insurance company claims data.

Discussed use of closed claims data from the 2004 and 2005 seasons.

Discussed quality control of Hurricane Ivan (2004) claims data to remove contribution of storm surge.

A-2 Event Definition

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

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

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

Discussed that the model loss costs do not include direct flood or storm surge.

A-3 Coverages*

*(*Significant Revision)*

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

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

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

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

Audit

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

Verified: YES

Professional Team Comments:

Discussed no change in the methodology for calculating building, appurtenant structure, contents, and time element losses.

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.

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

Audit

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

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

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

4. Provide a detailed description of how the model accounts for hurricane storm surge losses.

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

Pre-Visit Letter

23. A-4.C, page 145: Describe the process used to ensure that storm surge losses are excluded from the model's loss cost outputs.

Verified: YES

Professional Team Comments:

Discussed the process for excluding storm surge losses from the model loss output.

The Professional Team recommends the modeler present their process for excluding storm surge losses from the modeled losses to the Commission during the Trade Secret session.

Discussed that modeled loss costs do not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin, and the model does not make a prospective provision for economic inflation.

Discussed no change in methodology for producing probable maximum loss estimates.

Discussed no change in methodology for demand surge calculations.

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

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

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

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

Verified: YES

Professional Team Comments:

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

A-6 Loss Output*

*(*Significant Revision)*

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

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

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

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

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

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

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

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

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

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

1. masonry construction versus frame construction,

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

3. inland counties versus coastal counties, and

4. northern counties versus southern counties.

A-6 Loss Output (Continued)

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

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-8 (Probable Maximum Loss for Florida). Describe the hurricane associated with the Top Event.

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

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

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

5. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Forms A-1 (Zero Deductible Personal Residential Loss Costs by ZIP Code), A-2 (Base Hurricane Storm Set Statewide Losses), A-3A (2004 Hurricane Season Losses, 2007 FHCF Exposure Data), A-3B (2004 Hurricane Season Losses, 2012 FHCF Exposure Data), A-6 (Logical Relationship to Risk, Trade Secret item), and A-7 (Percentage Change in Logical Relationship to Risk) will be used to assess coverage relationships.

6. Demonstrate that loss cost relationships among deductible, construction type, policy form, coverage, building code/enforcement, building strength, condo unit floor, number of stories, territory, and region are consistent and reasonable.

7. The total personal and commercial residential insured losses provided in Forms A-2 (Base Hurricane Storm Set Statewide Losses), A-3A (2004 Hurricane Season Losses, 2007 FHCF Exposure Data), and A-3B (2004 Hurricane Season Losses, 2012 FHCF Exposure Data) will be reviewed individually for total personal residential and total commercial residential insured losses.

8. Forms A-4A (Output Ranges, 2007 FHCF Exposure Data), A-4B (Output Ranges, 2012 FHCF Exposure Data), and A-5 (Percentage Change in Output Ranges, 2007 FHCF Exposure Data) will be reviewed, including geographical representations of the data when applicable.

9. Justify all changes in loss costs from the previously accepted submission.

10. Forms A-4A (Output Ranges, 2007 FHCF Exposure Data) and A-4B (Output Ranges, 2012 FHCF Exposure Data) will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.

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

Pre-Visit Letter

24. Form A-4B, page 294: Describe how the file hlpm2012c.txt was processed for use in completing Form A-4B.

25. Form A-5, page 311: Explain the changes in the North in relation to those in other areas.

26. Form A-5, page 312: Explain the changes indicated for Madison and Hamilton Counties in Figure 86.

27. Form A-5, page 313: Explain the change for Monroe County in Figure 87.

28. Form A-5, page 317: Explain the changes for Palm Beach, Broward, and Miami-Dade Counties in Figure 91.

29. Form A-5, page 318: Explain the difference for Santa Rosa County in Figure 92.

30. Form A-7, page 331: Explain Coastal Commercial Residential changes by Story in Table 55.

Verified: YES

Professional Team Comments:

Discussed the rationale for ZIP Codes with lower percentage changes in Form A-1 for frame and masonry from the previous submission.

Discussed no differentiation for mobile home between coastal and inland regions in Form A-1 loss costs.

Discussed the changes in Form A-2 losses due to events updated based on the HURDAT2 reanalysis.

Discussed the changes in 2004 event losses in Form A-3A for ZIP Codes 33951, 32957, and 32561.

Discussed the percentage changes for commercial residential in Form A-7.

Reviewed the results in Trade Secret Form A-6. Form A-6 was subsequently revised.

Discussed the procedures for processing the aggregate FHCF 2012 exposure data in completing Form A-4B.

Discussed the changes in Form A-5 for the North in relation to those in other areas.

Discussed the changes in Form A-5 in Madison and Hamilton Counties for owners frame in Figure 86.

Discussed the changes in Form A-5 in Monroe County for owners masonry in Figure 87.

Discussed the changes in Form A-5 in Palm Beach, Broward, and Miami-Dade Counties for condo-unit frame in Figure 91.

Discussed the changes in Form A-5 in Santa Rosa County for condo-unit masonry in Figure 92.

Reviewed state color-coded roughness length maps over-water and over-land and the effects on loss costs.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-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. Development of the documentation shall be indicative of accepted software engineering practices.

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

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

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

Audit

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

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

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

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

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

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

7. Trace the model changes specified in Standard G-1 (Scope of the Computer Model and Its Implementation), Disclosure 5 through all Computer Standards.

Pre-Visit Letter

31. C-1.B, page 155: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Reviewed the errors found after the November 2014 submission, which did not require rerunning the output ranges. The errors were associated with filling out the Forms S-5, A-2, A-7, and A-8. The errors, which resulted from a manual process, were corrected in the January 7, 2015 submission.

Reviewed the primary document binder and associated sub-documents relating to Standards C-1 through C-7 as required by audit items 1 through 6.

Reviewed the single table required by Standard C-1.D for the model version under review. This was the table for changes to the model resulting in the January 7, 2015 submission, which addressed the deficiencies specified in the pre-visit letter to the modeler based on their November 2014 submission.

Reviewed documentation for the process used by the modeler to ensure correspondence among different types of media (e.g., design documents versus design code).

Reviewed the 2012 FHCF and Form A-4B EDM Development Overview document and changes made to the document during the audit.

Reviewed RiskLink 15.0 Technical Specifications that list updates to the flowchart-based processes for generating Forms S-5, A-2, A-7, and A-8.

Reviewed RiskLink 15.0 Technical Specifications that list updates to the flowchart based-processes for generating Form A-4.

Reviewed RiskLink 15.0 Technical Specification for distance to coast hazard configuration.

Traced model changes from Standard G-1, Disclosure 5 through the Computer Standards as required in Standard C-1, Audit Item 7.

C-2 Requirements

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

Audit

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

Pre-Visit Letter

32. C-2, pages 156-157: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed the requirements, specified in tabular form, for all items in Standard G-1, Disclosure 5.

C-3 Model Architecture and Component Design*

*(*Significant Revision)*

The modeling organization shall maintain and document (1) detailed control and data flow diagrams and interface specifications for each software component, (2) schema definitions for each database and data file, and (3) diagrams illustrating model-related flow of information and its processing by modeling organization personnel or team. Documentation shall be to the level of components that make significant contributions to the model output.

Audit

1. The following will be reviewed:
    a. Detailed control and data flow diagrams, completely and sufficiently labeled for each component,
    b. Interface specifications for all components in the model,
    c. Documentation for schemas for all data files, along with field type definitions,
    d. Each network diagram including components, sub-component diagrams, arcs, and labels, and
    e. Diagrams illustrating model-related information flow among modeling organization personnel or team (e.g., using Unified Modeling Language (UML), Business Process Model and Notation (BPMN), or equivalent technique including a modeling organization internal standard).

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

Verified: YES

Professional Team Comments:

Reviewed the flowcharts associated with processing Forms S-5, A-2, A-4A, A-4B, A-7, and A-8. Discussed new approaches to mitigating errors that resulted during form preparation.

Reviewed a flowchart for defining form dependencies, as a way to mitigate future form generation errors.

Reviewed the hazard library redesign flowchart.

Reviewed the Form A-4B Generation Plan flow diagram.

Reviewed the flowchart for updating the ZIP Code databases.

Reviewed the data structures and databases for managing ZIP Codes.

C-4 Implementation

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

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

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

Verified: YES

Professional Team Comments:

Reviewed the Python code used inside of form generation process, as well as the source code modification to this code to address an error in the total number of storm years.

Verified that the modeler's documented process for coding guidelines has not changed since the previous submission.

Reviewed an equation table for long term landfall rate updates corresponding to Standard C-4.F.

Reviewed distance to coast algorithm and implementation.

Reviewed the implementation of the equation for calculating long term landfall rates.

Reviewed process and implementation to calculate Form A-7 from Form A-6 from this submission and the previous submission.

Discussed the new coastline smoothing process, which is manually intensive.

Discussed the manual verification process associated with checking the accuracy of the new Land Use Land Cover (LULC) data.

Reviewed the spreadsheet calculation performed to create the percentages for creating Form A-7.

C-5 Verification*

*(*Significant Revision)*

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

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

4. 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

33. C-5, pages 163-166: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Verified that there were a number of forms that were in error, but that this did not affect loss costs in Form A-4A and Form A-4B. Discussed that the modeler should create a written plan to mitigate against future errors for populating forms required in the submission. Reviewed the plan that was created on-site.

Reviewed general testing and verification procedures.

Reviewed changes to Test Plan for 2014 FCHLPM Actuarial Form Output implemented to verify the number of years in the historical event rates used in completing Form A-2.

Reviewed the process for completing actuarial forms documented in Creation of the Actuarial Forms of the FCHLPM submission.

Reviewed the Quality Assurance (QA) process associated for populating Form A-1.

Reviewed a unit test for the equation associated with long term landfall rate updates.

Reviewed the flowcharts defining verification procedures for LULC data.

Discussed that the method of merging LULC data is manually intensive.

Reviewed the root cause analysis procedure used by the modeler as part of their enhanced QA methods for form generation.

Reviewed test plan associated with Form A-4B generation.

Reviewed the Detailed Loss Model (DLM) Engineering Development Specification.

Reviewed the RiskLink 15.0 Component Methodology for North Atlantic Hurricane Long Term Rate Updates testing and code implementation.

C-6 Model Maintenance and Revision*

*(*Significant Revision)*

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

B. A revision to any portion of the model that results in a change in any Florida residential hurricane loss cost 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 maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, provide the installation date under configuration control, the current version identification, and the date of the most recent change(s).

2. The policy for model revision will be reviewed.

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

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

Pre-Visit Letter

34. C-6.D, page 168: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Discussed that the software tool for software maintenance has not changed since the previous submission.

Reviewed a more detailed version of the policy for model revision on-site.

Reviewed the model version history over the past 5 years culminating in the most recent model version.

C-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed that there were no security breaches related to the model since the last accepted model.

Discussed that the policy for security has been updated since the prior audit to include compliance training as an integral and ongoing part of corporate culture.