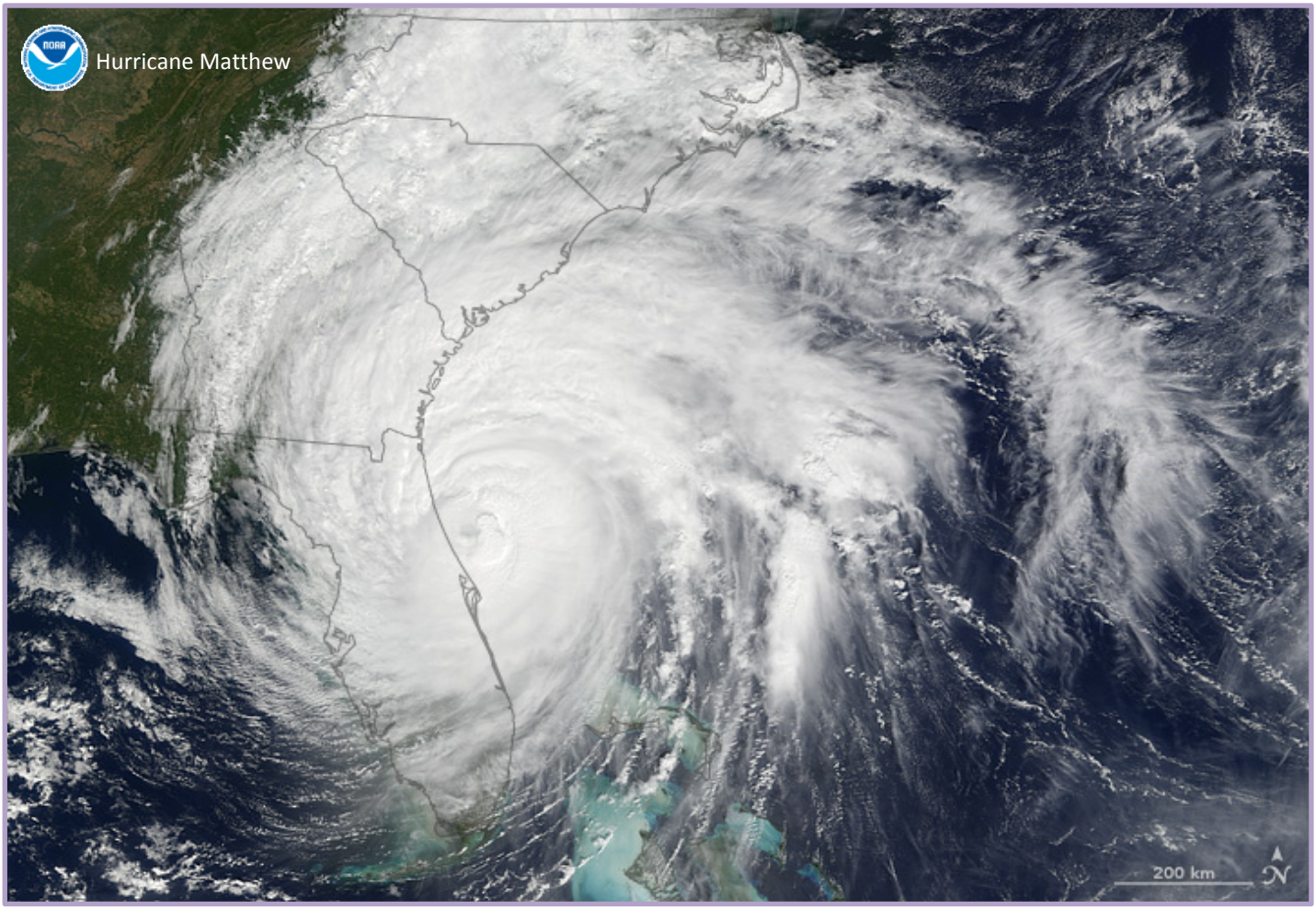
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report

2015 Standards



Risk Management Solutions, Inc.

On-Site Review

April 10-12, 2017

On April 10-12, 2017, the Professional Team visited Risk Management Solutions, Inc. (RMS) in Newark, California. The following individuals participated in the review:

RMS

Yasuyuki Akita, Geospatial Modeler
Catherine Ansell, Ph.D., Manager, Model Development
Enrica Bellone, Ph.D., Senior Director, Model Development
Kay Cleary, FCAS, MAAA, FCA, Actuary & Director (via phone)
Peter Datin, Ph.D., Senior Principal Modeler, Model Development
Michael Drayton, Ph.D., Consultant
David Gatey, Ph.D., Senior Principal Modeler, Model Development
Sarah Hartley, Senior Modeler, Model Development
Tim Huth, Associate Product Manager, Risk Analytics
Jo Kaczmarska, Ph.D., FIA, Principal Modeler, Model Development
Michael Kozar, Ph.D., Senior Modeler, Model Development
Ran Li, Geospatial Modeler
Joss Matthewman, Ph.D., CCRA, Senior Principal Modeler, Model Development
Akwasi Mensah, Senior Modeler
Roopa Nair, Product Manager, Risk Analytics
Mark Powell, Ph.D., Vice President of Model Development
Mohsen Rahnama, Ph.D., General Manager, Models and Data, Chief Risk Modeling Officer
Christina Robertson, CCRA, Lead Modeler, Model Development
Tom Sabbatelli, CCRA, Senior Product Manager, Model Product Management
Chris Sams, Senior Product Manager, Geospatial Development
Emilie Scherer, Ph.D., CCRA, Principal Modeler, Model Development
Bronislava Sigal, Ph.D., Director, Modeling
Ajay Singhal, Ph.D., Senior Vice President, Model Development
Beth Stamann, Senior Documentation Specialist
Derek Stedman, Senior Modeler
Shahram Taghavi, Ph.D., P.E., Vice President, Model Development
Joel Taylor, CCRA, Senior Manager Model Product Management
Patxi Uriz, Ph.D., P.E., Principal Modeler
Vahid Valamanesh, Senior Modeler
Yogesh Vani, Senior Manager Software
Rajkiran Vojjala, Vice President, Model Development
Paul Wilson, Vice President, Model Development
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
Mike Smith, FCAS, FSA, MAAA, OMCAA, Actuary
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Donna Sirmons, Staff

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

RMS provided an explanation of the labeling error to Table 57 in Form A-8, Part B in the previously accepted model submission as reported to the Commission in the January 18, 2017 letter. The Professional Team reviewed the data that was used in creation of the form and verified the form was produced with the correct data. RMS provided a modified editorial checklist adding an explicit check for FHCF vintages used in form completion to those reported in the final document to prevent a recurrence of the error.

RMS next provided an overview of the RMS North Atlantic Hurricane Models and the following significant changes in the model:

- Updates to the geocoding module to include December 2015 postal code vintage data.
- Integration of U.S. Postal Service street information to supplement existing street geocoding files.
- Stochastic event set updated to the September 2015 version of HURDAT2 and the 1946-1955 reanalysis data.
- Historical footprints for 12 events revised from the HURDAT2 1946-1955 re-analysis.
- Updates to the surface roughness data using more current satellite imagery incorporating new areas of urban growth.
- New year-built bands manufactured home structures with tie-downs, updates to manufactured homes inventory distributions, and differentiation by Housing and Urban Development (HUD) zone.
- Recalibration of multi-family dwelling vulnerability and contents including updates to condominium association and unit-owners.
- Introduction of unique damage curves for unreinforced masonry and reinforced masonry construction classes.
- Activation of construction quality secondary modifiers for manufactured homes.
- New values for secondary characteristics roof covering, roof equipment hurricane bracing, wall cladding type, and residential appurtenant structures attached and detached screen enclosures and roof-mounted solar panel arrays.

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. Methodology and new claims data for updates to manufactured homes and multi-family dwelling vulnerability
2. Classification of inventory region assignments
3. Updates to masonry and secondary modifiers
4. Justification for the construction classes and characteristics used in the model.
5. Justification for modifications to the building vulnerability functions due to building codes and their enforcement including use of year of construction and/or geographical location of the building if used as a surrogate for building code and code enforcement.
6. Methodology for reinforced masonry and the exposure data and its consistency with the prevailing Florida Building Code and code enforcement.
7. Method for excluding storm surge losses from the modeled losses.
8. Detailed information and discussion of Form V-3 as specified on page 55 of the *Report of Activities*.

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

The Professional Team reviewed the following corrections to be included in the revised submission which is to be provided to the Commission no later than 10 days prior to the meetings for reviewing models for acceptability. Page numbers below correspond to the October 31, 2016 submission.

- Pages 23-24, G-1 Disclosure 4 – additional Meteorological Standards references added
- Page 34, G-1 Disclosure 5 – revised to include building inventory, to clarify changes for secondary modifiers under vulnerability module changes, and assignment of some ZIP Codes to county total insured value (TIV)
- Page 35, G-1 Disclosure 5 – revised to correct the model build used for the model comparisons
- Page 61, M-2 Disclosure 4 – revised to clarify treatment of observed hurricanes
- Page 108, V-1 Disclosure 2 – Figure 43 revised to update formatting of flowchart
- Page 109, V-1 Disclosure 3 – revised to correct amount of claims data used for manufactured homes and multi-family dwelling
- Page 117, V-2 Disclosure 2 – reference to Figure 45 process flowchart added
- Page 118, V-2 Disclosure 5 – Figure 46 revised to update formatting of flowchart
- Page 120, V-3 Disclosure 1 – revised to clarify updates to secondary modifiers
- Pages 123-124, V-3, Disclosure 3 – Table 16 revised for 12-Commercial Appurtenant Structures and 16-Residential Appurtenant Structures to clarify updates to secondary modifiers
- Page 282, Form A-8 – revised to correct the labeling of the FHCF exposure used in Parts B and C

Report on Deficiencies

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

1. Standard G-3, Disclosure 5 (page 54)
   Response is incomplete as other ZIP Code-based databases and the process for updating ZIP Code databases are not given.

2. Standard S-1, Disclosure 6 (page 98)
   Response is incomplete as goodness-of-fit results for Amax are not given.

3. Standard V-1, Disclosure 8 (page 113)
   Response is incomplete as a description of the relationship between structural and appurtenant structure vulnerability functions and consistency with insurance claims data are not given.

4. Standard V-3.A (page 120)
   Response is incomplete as the impact of mitigation measures on associated uncertainties is not given.

5. Standard A-1, Disclosure 2 (page 128)
   Response is incomplete as a sample calculation for determining the amount of depreciation and the actual cash value losses is not given.

Discussion on Inquiries

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

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

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

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

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

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

Some of this material may have been shown or may have been available on a previous visit by the Professional Team. The Professional Team will also be considering material in

response to deficiencies and issues designated by the Florida Commission on Hurricane Loss Projection Methodology (Commission).

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

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

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

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

Refer to the On-Site Review section of the *Report of Activities as of November 1, 201*5 for more details on materials to be presented to the Professional Team. Please pay particular attention to the requirements under Presentation of Materials on pages 73-74. In addition, please provide six printed copies of the tables required in Standard CI-1, Audit 6.
For your information, the Professional Team will arrive in business casual attire.

The pre-visit comments are grouped by standards sections.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Model and Its Implementation*

*(*Significant Revision)*

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

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

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

Audit

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

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

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

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

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

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

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

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

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

Pre-Visit Letter

1. G-1, Disclosure 5.B, page 35: Provide percentage differences for the stochastic module and the wind field module.

2. G-1, Disclosure 5.B, Table 1, page 35: Provide more significant digits to percentage difference by module.

3. G-1, Disclosure 5.B, Table 1, page 35: Reconcile the 1.5% decline in Table 1 with the increase of 15% in the mean (Total Average Annual Loss) in Form S-2 (page 187) as well as the positive shift in the loss exceedance curves. Form S-5 has a 1.51% decline. Explain the apparent inconsistencies.

4. G-1, Disclosure 5.B.1, page 35: Clarify the build used for the comparisons.

5. G-1, Disclosure 5.C, Figure 4, page 36: Explain the differences in geocoding impacts for the pairs of counties Alachua versus Putnam and Pasco versus Hillsborough. Explain why no other counties are impacted.

6. G-1, Disclosure 5.C, Figure 5, page 37: Identify the aspects of Sumter County that causes it to have the most extreme impact due to hazard.

7. G-1, Disclosure 5.C, Figure 5, page 37: Explain increases in loss costs for Union and Levy counties due to Hazard Module changes while all the neighboring counties have reductions in loss costs.

8. G-1, Disclosure 5.C, Figure 6, page 38: Explain why Collier, Union, and Palm Beach counties are most impacted by vulnerability changes.

9. G-1, Disclosure 5.C, Figure 6, page 38: Explain why Union County has an increase in loss costs due to vulnerability changes whereas close by Duval County has a reduction in loss costs.

10. G-1, Disclosure 5.D, Figure 7, page 40: Present the model runs and background calculations which led to identification of Collier and Putnam counties as the location for overall maximum and minimum impact due to all model changes together.

Verified: YES

Professional Team Comments:

Discussed with the modeler the scope of "Model" (reference 2015 Report of Activities, page 224) as the scope pertains to the audit.

Reviewed in detail the model changes provided in Disclosure 5 and several revisions to the wording.

Reviewed the statewide percentage differences for the updates to the stochastic landfall rates and the land use land cover (LULC) update in the windfield module.

Discussed the percentage changes given in G-1 Disclosure 5.B, Form S-2, and Form S-5.

Discussed the model build used in the submission comparisons was actually RiskLink 15.0 (Build 1625) and the build given on page 35 was a typographical error that was corrected during the audit.

Discussed the differences in geocoding impacts for Alachua versus Putnam counties and Pasco versus Hillsborough counties. Reviewed maps for the change in county assignments for ZIP Code resolution exposures.

Reviewed the changes in LULC and stochastic landfall rates impacting the percentage changes in Sumter, Union, Dixie, and Levy counties.

Reviewed the changes in multi-family dwelling affecting both commercial residential and condo-unit owners impacting the percentage changes in Collier County and the changes in commercial residential inventory distribution impacting Palm Beach County.

Reviewed the changes in manufactured homes impacting the percentage changes in Union County.

Reviewed the calculations leading to the maximum and minimum percentage changes in Collier and Putnam counties for all model updates.

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

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

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

Audit

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

2. Forms G-1, General Standards Expert Certification, G-2, Meteorological Standards Expert Certification, G-3, Statistical Standards Expert Certification, G-4, Vulnerability Standards Expert Certification, G-5, Actuarial Standards Expert Certification, G-6, Computer/Information Standards Expert Certification, and all independent peer reviews of the model under consideration will be reviewed. Signatories on the individual forms will be required to provide a description of their review process.

3. Incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession will be discussed.

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

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Yasuyuki Akita, Ph.D. Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, NC; M.S. Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, NC; M.S. Physics, Sophia University, Tokyo, Japan; B.S. Physics, Sophia University, Tokyo, Japan

- Catherine Ansell, Ph.D. Physics, Imperial College, London, UK; M.S. Physics of Atmospheric & Oceans and Astrophysics, Merton College, University of Oxford, Oxford, England
- Sarah Hartley, M.Sc. Applied Meteorology, University of Reading, Reading, Berkshire, England; B.S. Physcial Geography, University of Reading, Reading, Berkshire, England
- Tim Huth, M.A. Environmental Studies, Brown University, Providence, RI; B.A. Science of Earth Systems, Cornell University, Ithaca, NY
- Akwasi Mensah, Ph.D. Civil I Engineering, Rice University, Houston, TX; M.S. Civil Engineering, University of Florida, Gainesville, FL; B.S. Civil Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
- Roopa Nair, M.S. Statistics, Delhi University from Hindu College, New Delhi, India; B.S. Statistics, Delhi University, New Delhi, India
- Thomas Sabbatelli, M.S. and B.S. Meteorology, Penn State University, State College, PA
- Daniel Temesi, M.S. Computer Science and Economics, University of Szeged, Szeged, Hungary
- Vahid Valamanesh, Ph.D. Structural Engineering, Northeastern University, Boston, MA; Ph.D. Earthquake Engineering, Sharif University of Technology, Tehran, Iran; M.S. Structural Engineering, Sharif University of Technology, Tehran, Iran; B.S. Civil Engineering

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

G-3 Insured Exposure Location

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

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

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

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

E. Geocoding methodology shall be justified.

Audit

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

Verified: YES

Professional Team Comments:

Reviewed geographic displays of ZIP Codes and comparisons of centroid movements and boundary shifts for the entire state.

Discussed the methodology used to update and validate the ZIP Code database.

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

Reviewed examples of geocoding for complete and incomplete street addresses.

Reviewed examples of latitude-longitude to ZIP Code conversions.

Reviewed the ZIP Code-based databases used in the model. Reviewed table of current ZIP Code and population-weighted centroids generated from the geocoding module.

G-4 Independence of Model Components

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

Audit

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

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

Verified: YES

Professional Team Comments:

There was no evidence to suggest 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 Review Expert Certification that the submission has been personally reviewed and is editorially correct.

Audit

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

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

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

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

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

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

Verified: YES

Professional Team Comments:

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

Reviewed revised flowchart for completion of Form A-4.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

11. M-1, page 58: Changes in the Base Hurricane Storm Set will be reviewed. Storm names in Form A-2 will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the update to the historical catalog based on HURDAT2 downloaded September 2015. Discussed the methodology for updating landfall frequencies, smoothing the historical landfall rates, and defining the stochastic model landfall rates. Discussed the simulation approach for processing the data for updates to the historical footprints.

Reviewed the following updates to the historical catalog:

- Twelve storms were modified based upon the HURDAT2 reanalysis project (1946-1955)
- One storm removed: Hurricane Fox (1952)
- One storm added: Hurricane Hazel (1953)
- Landfall coastal segments for six Florida landfalls were changed: NoName09 (1947), NoName08 (1948), NoName09 (1948), Hurricane Easy (1950), Hurricane King (1950), and Hurricane Hazel (1953). Reviewed comparison of previous and current track changes for these six historical storms.

Reviewed comparison of smoothing HURDAT2 data by landfall gate for Category 1 and 2 storms.

Reviewed comparison of previous and current HURDAT2 and stochastic landfall counts by region.

Reviewed the change in loss costs related to the landfall frequency update.

Reviewed flowchart for constructing historical windfields from HURDAT2.

Reviewed Form A-2 with storm numbers added to those listed in the submission as NotNamed-year.

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

Discussed the consistency of Forms M-1 and S-1.

M-2 Hurricane Parameters and Characteristics

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

Audit

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

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

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

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

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

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

Verified: YES

Professional Team Comments:

Discussed updates to hurricane parameter fits based on updated hurricane datasets.

Documentation reviewed:

- "Characteristics of United States Hurricanes Pertinent to Levee Design for Lake Okeechobee, Florida," Hydrometeorological Report No. 22, Vance A. Myers, Division of Hydrologic Services, Hydrometeorological Section, U.S. Department of Commerce Weather Bureau, U.S. Department of Army Corps of Engineers, Washington, D.C., March 1954.

Response to Disclosure 4 revised to clarify treatment of historical events.

M-3 Hurricane Probabilities

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

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

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

Saffir-Simpson Hurricane Scale:

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

Audit

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

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

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

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

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

Pre-Visit Letter

12. M-3, page 65: The updated landfall frequency distribution will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the updated landfall frequency distributions and comparisons of historical versus modeled landfall frequencies. Discussed no change in the process for developing the distributions.

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

Discussed validation of stochastic storm windfields by comparing distributions of significant wind radii. Reviewed frequency histograms of observed and simulated (i) radius of hurricane force winds, and (ii) radius of gale force winds. Discussed the number of storm observations are taken from the extended best track database.

Discussed method for deriving historical values of X_1, the decay length for the windfield profile outside Rmax. Reviewed frequency histogram for X_1 compiled from historical storms.

Discussed distributions of storm heading at landfall by region (Figure 12). Reviewed histogram with finer heading bins. Discussed comparison of the two distributions.

Discussed North Atlantic basin distribution of maximum wind angle from heading (Figure 40).

Discussed the combined impacts of landfall heading and maximum wind angle on storm windfield at landfall.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

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

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

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

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

Audit

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

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

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

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

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

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

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

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

Pre-Visit Letter

13. M-4, page 67: Updated hurricane wind footprint analyses for 12 events in the period 1946-1955 will be reviewed.

14. M-4, Disclosure 8, page 70: The method for converting land use and land cover data into a spatial distribution of roughness coefficients in Florida and neighboring states will be reviewed.

16. Form M-2, pages 176-182: The differential in windspeed between actual and open terrain will be reviewed.

17. Form M-2, pages 177-178: Figures 57 and 58 will be reviewed and the location of maximum windspeed of 155 mph and 153 mph in the regions with windspeed between 125 and 140 mph will be discussed.

18. Form M-2, page 182: Figure 62 will be reviewed and the location of minimum windspeed of 64 mph in the region with windspeed between 65 and 80 mph will be discussed.

Verified: YES

Professional Team Comments:

Reviewed the methodology for updating land use and land cover (LULC) data from National Land Cover Database (NLCD) 2006. Discussed no change in the methodology, only the underlying LULC data was updated where necessary to be consistent with the National Land Cover Database 2011 vintage or newer. Discussed the process for adjusting the LULC based on ASTER satellite data.

Reviewed flowchart for the LULC update methodology. Discussed no change in the LULC methodology.

Reviewed Google Earth and satellite examples of changes to the LULC data.

Reviewed summary of LULC changes by vegetation classes.

Reviewed map of LULC changes in Florida identified as vegetation or non-vegetation related. Reviewed specific examples in Union and Sumter counties.

Reviewed comparison of previous and current hurricane track and intensity changes and comparison maps of the spatial distribution of winds with storm tracks plotted for Hurricane Florence (1953), Hurricane Hazel (1953), Hurricane Baker (1950), Hurricane Easy (1950), Hurricane King (1950), NoName02 (1949), NoName09 (1948), NoName08 (1948), NoName09 (1947), NoName04 (1947), and NoName06 (1946).

Reviewed map of windfield for Hurricane King (1950).

Reviewed maps of open terrain, actual terrain, and differences for maximum historical, stochastic 100-year return period, and stochastic 250-year return period windspeeds.

Reviewed comparisons of Form M-2 maximum historical windspeed maps for open and actual terrain. Discussed that the maximum and minimum statewide values are based on ZIP Code resolution versus color contour resolution using interpolated values.

Reviewed the change in loss costs related to the historical footprint reconstructions.

Discussed the changed loss costs for NoName08 (1948), considering changes in track and windfield compared to exposure locations.

Reviewed the track of the Top Event.

M-5 Landfall and Over-Land Weakening Methodologies

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

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Discussed no change in the model over-land weakening rate methodology.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

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

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

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

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

Pre-Visit Letter

15. M-6, page 84: Methods (including any software) used in verifying logical relationships among hurricane characteristics will be reviewed.

19. Form M-3, page 183: The wind-pressure relation for weaker storms (higher pressure) will be reviewed.

Verified: YES

Professional Team Comments:

Discussed methodology for verifying logical relationships between hurricane characteristics.

Reviewed comparison of HURDAT2 versus the model median pressure/wind relationship.

Reviewed comparison of historical to modeled Vmax.

Reviewed the wind-pressure relationship for weaker storms in Form M-3. Discussed radii distributions for 110 mph threshold and Rmax for storms in 980 mb band.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

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

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

Pre-Visit Letter

20. S-1, Disclosure 1, pages 87-88: Justify the Poisson distribution as a model for storm frequency relative to a negative binomial (gamma Poisson).

21. S-1, Disclosure 6, pages 93-97: Explain the changes in the *p*-values for the various fits using the incremental data for this submission versus the previous submission.

22. S-1, Disclosure 6, Figure 40, page 98: Provide the comparison for Florida only storms.

Verified: YES

Professional Team Comments:

Reviewed goodness-of-fit tests for single-family dwelling, 1 story, unreinforced and reinforced masonry.

Discussed the probability distribution fits and severity distributions for conditional exceedance probability curves.

Reviewed the Poisson distribution for storm frequency relative to a negative binomial fit and the parameter estimates.

Reviewed the Chi-square goodness-of-fit test for Florida landfalling hurricanes.

Reviewed various Chi-square and Kolmogorov-Smirnov goodness-of-fit tests for changes in central pressure, Rmax, Vmax, and translational speed in the historical and stochastic storm sets.

Reviewed Figure 40 reproduced for hurricanes in two domains close to Florida.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed no changes in model methodology from the previous submission.

Verified that no new sensitivity tests were required.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed no changes in model methodology from the previous submission.

Verified that no new uncertainty tests were required.

S-4 County Level Aggregation

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

Audit

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

Verified: YES

Professional Team Comments:

Discussed process for generating the stochastic catalog. Reviewed convergence results for Nassau, Monroe, Miami-Dade, and Hillsborough counties.

S-5 Replication of Known Hurricane Losses

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

Audit

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

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

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

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

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

Verified: YES

Professional Team Comments:

Reviewed Form S-4 results.

Discussed the underlying claims data used in Tables 11 and 12.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed Form S-5.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Building Vulnerability Functions*

*(*Significant Revision)*

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

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

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

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

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

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

Pre-Visit Letter

23. V-1, Disclosure 3, pages 109-110: Discuss in detail the response, particularly the new data (e.g., Company V in Table 13) and updated loss data for various occupancies. Explain why the amount of loss data for manufactured homes decreased.

24. V-1, Disclosure 6, page 113: Explain how the renter and apartment building owner occupancies are addressed in Table 15.

25. V-1, Disclosure 8, page 114: Explain, in spite of changes in the model including changes in vulnerability functions, how Figure 44 was developed using the current model and how the data was produced and processed.

26. V-1, Disclosure 10, page 114: Present in detail the "logic to pick up the most appropriate vulnerability curve" when input data are conflicting.

27. V-1, Disclosure 13, page 115: Explain "model includes secondary modifier options to alter the likelihood of building envelope breaches and thus control water infiltration."

Verified: YES

Professional Team Comments:

Reviewed updates to manufactured home vulnerability functions to vary by region to align better with Housing and Urban Development (HUD) code using research from the Insurance Institute for Business and Home Safety (IBHS), post-storm field investigations, and additional claims analysis.

Discussed new analysis of claims data from Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Jeanne (2004), Hurricane Ivan (2004), Hurricane Irene (2011), and Hurricane Sandy (2012).

Reviewed the manufactured homes claims data by region.

Reviewed construction classes for manufactured homes based on tie-downs. Reviewed the new year built age band for manufactured homes with tie-downs. The previous year band of 1995 or later was split to 1995-2008 and 2009 or later.

Reviewed the regional differentiation for manufactured homes by HUD zone and mapping of HUD zones to the model vulnerability regions.

Reviewed comparison of the updated vulnerability functions for manufactured homes with tie-downs by year built age bands to the previous vulnerability functions.

Reviewed mean damage ratios for manufactured homes with tie-downs for year built age band 2009 or later for HUD Zones 2 and 3 by windspeed bands.

Reviewed the mean damage ratio between manufactured home pre-1975 with tie downs and without tie downs by windspeed bands.

Reviewed the update to inventory weights for manufactured homes in Florida by region for year-built age band.

Documentation reviewed:

- "Manufactured Homes, Surviving Severe Windstorms," Disaster Safety Review, Insurance Institute for Business and Home Safety, 2015, Volume 1, pages 17-19.

- Installation Course for Manufactured Housing, Division of Motorist Services, Manufactured Housing Section, Installer Licensing Program, Florida Department of Highway Safety and Motor Vehicles, January 2011.

Discussed the basis for recalibrating the building and contents functions for multi-family dwelling vulnerability. Reviewed new multi-family dwelling claims data from Hurricane Wilma (2005).

Discussed contribution of analytical modeling and engineering judgment in development of multi-family dwelling, commercial residential, and condo-unit owner vulnerability functions.

Reviewed flowchart for analyzing multi-family dwelling claims data. Flowchart was revised and reviewed during the audit.

Reviewed the component vulnerability model and the parameters that define each component. Reviewed the methodology combining components to create vulnerability functions.

Reviewed the mean damage ratios for each component of the component vulnerability model by windspeed bands. Reviewed the mean damage ratio between multi-family dwelling and large single-family dwelling by windspeed bands.

Reviewed comparison of mean damage ratios between the current and previous model for multi-family dwelling low-rise and high-rise by windspeed bands.

Discussed the development and validation of commercial residential condo association and condo-unit owners vulnerability functions.

Reviewed graphical comparison of modeled and actual condo-unit owner losses for Hurricane Wilma (2005).

Reviewed graphical comparison of modeled and actual multi-family dwelling losses for Hurricane Wilma (2005).

Reviewed update to the multi-family dwelling inventory which is used when one or more of the primary building characteristics is unknown. Discussed the update based primarily on the RMS independent and proprietary Exposure Source Database (ESDB).

Discussed the data sources for the ESDB. Reviewed table of summary statistics for both commercial and residential buildings in the ESDB. Discussed the process for reviewing and updating the ESDB.

Discussed how changes in the multi-family dwelling inventory drive some of the changes in the actuarial forms.

Reviewed multi-family dwelling number of stories distribution in Florida from the RMS ESDB.

Reviewed multi-family dwelling inventory distributions for wood, masonry, and concrete constructions.

Reviewed the two new masonry construction classes added for unreinforced masonry and reinforced masonry. Discussed the new masonry construction classes had no impact on vulnerability or actuarial forms as the default masonry vulnerability is used for completion of all forms.

Reviewed IBHS research results on unreinforced and reinforced masonry. Unreinforced masonry buildings had catastrophic wall failure once the roof lifted off where reinforced masonry buildings did not suffer such structural failures. Discussed newer construction is more likely to have reinforcing than older construction, but reinforcement is not mandated everywhere.

Reviewed mean damage ratios for masonry, unreinforced masonry, and reinforced masonry construction classes by windspeed bands.

Reviewed claims validation plot for pre-1995, 1 story, single-family dwelling, unreinforced and reinforced masonry damage ratios for Hurricane Andrew (1992).

Reviewed renter and apartment building owner occupancies in Table 15, RMS Hurricane Primary Building Classification Options.

Reviewed comparison of appurtenant structure claims for single-family dwelling and modeled mean damage ratios versus peak gust windspeed. Discussed no change in single-family dwelling vulnerability.

Reviewed the methodology for selecting vulnerability curves when input data are conflicting. Reviewed flowchart for vulnerability curve selection and its implementation in the source code.

Reviewed secondary modifiers affecting envelope breaches and subsequent water infiltration.

Discussed the impact of square footage on multi-family dwelling vulnerability functions.

Discussed justification for the construction classes and characteristics.

Discussed process for reviewing changes to the Florida Building Code and the application of the building code and its enforcement in development of the building vulnerability functions.

Discussed changes in Form V-1 losses due to change in the reference structures.

V-2 Derivation of Contents and Time Element Vulnerability Functions

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

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

Pre-Visit Letter

28. V-2, Disclosure 2, page 117: Explain how CVM applies to the development of contents vulnerability functions. Provide an example application of the flowchart given in Figure 43 (page 108).

29. V-2, Disclosure 5, page 118: Explain the process in Figure 45, particularly the Vulnerability Development box.

Verified: YES

Professional Team Comments:

Reviewed mean damage ratios for concrete multi-family dwelling, single-family dwelling, and condo-unit owners contents vulnerability by windspeed bands. Discussed the calculation of contents losses and the relationships to building losses.

Reviewed comparison of contents mean damage ratios to structure mean damage ratios for the different construction classes.

Reviewed the new contents to building relationship for low-rise concrete and steel multi-family dwelling. Discussed no change in the contents vulnerability curves for all other construction classes.

Discussed the development of contents vulnerability functions using claims based contents to building relationships. Reviewed a flowchart created during the audit in response to Disclosure 2.

Reviewed comparison of contents damage ratio to building damage ratio based on insurance claims data for all construction classes.

Reviewed mean damage ratio contents and building function relationships for single-family dwelling, multi-family dwelling frame and masonry, and multi-family dwelling low-rise concrete constructions by windspeed bands.

Reviewed implementation of time element vulnerability. Discussed no change in the time element versus building relationships.

Reviewed comparison of time element damage ratio to building damage ratio based on insurance claims data.

Reviewed certain mean damage ratios for relationships between time element and building types by windspeed bands.

Discussed the justification and documentation for the development and dependence of contents vulnerability functions on all building primary attributes including occupancy and construction.

V-3 Mitigation Measures

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

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

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

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

Audit

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

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

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

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

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

Pre-Visit Letter

30. V-3.A, page 122: Discuss, in spite of the introduction of ASTM D3161 Class F and ASTM D7158 Class G and H shingles, the lack of these options in Roof Covering in Table 16.

Verified: YES

Professional Team Comments:

Reviewed the following secondary modifier updates:

- Construction Quality – new for manufactured homes which allows the ability to model retrofits and enhancements to tie-down systems used.
- Roof Equipment Hurricane Bracing – updated for single-family dwelling, multi-family dwelling, and manufactured homes to include option specifying no equipment present.
- Wall Cladding – updated for single-family dwelling and multi-family dwelling to separate stucco and exterior insulating foam system (EIFS) options, to add a none option, and to address wood siding.
- Roof Covering – updated for single-family dwelling and multi-family dwelling to add new options for concrete roof, Bermuda-style roof, and concrete roof with and without the presence of gutters.
- Residential Appurtenant Structures – updated for single-family dwelling, multi-family dwelling, and manufactured homes to add roof-mounted solar panel arrays options and to redefine screen enclosure options.

Reviewed plot of secondary modifiers for certified design and construction and obvious deterioration construction for pre-1995 and 1995-2008 year built by windspeed bands.

Reviewed plot of secondary modifiers for roof equipment hurricane bracing properly installed, no equipment present, and obvious signs of deficiencies in the installation.

Reviewed plot of secondary modifiers for EIFS and stucco wall cladding for low-rise frame construction pre-1995 and high-rise concrete construction 2002-2008 by windspeed bands.

Reviewed plot of secondary modifiers for wood siding for single-family and multi-family dwellings by windspeed bands.

Reviewed plot of secondary modifiers for concrete built-up roof with gutters and without gutters pre-1995 high-rise multi-family dwelling by windspeed bands.

Discussed the new classification options for asphalt shingles.

Reviewed plot of secondary modifiers for attached and detached screen enclosures by windspeed bands.

Reviewed plot of secondary modifiers for ballasted attachments and mechanically attached roof-mounted solar panels by windspeed bands.

Documentation reviewed:

- “Component Materials Evaluation Testing,” Disaster Safety Review, Insurance Institute for Business and Home Safety, 2013.

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

Reviewed changes between the previous and current Form V-2. Discussed impact of skylight at 85 mph and wall-foundation strength and wall-floor strength at 160 mph.

Discussed secondary modifier capping of credits and penalties at each windspeed.

Reviewed plot of secondary modifiers for wall-foundation strength and wall-floor strength.

ACTUARIAL STANDARDS – Mike Smith, Leader

A-1 Modeling Input Data and Output Reports

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed the quality assurance procedures and the process for reviewing the FHCF exposure data documented in the FHCF Exposure Data Module (EDM) Development Document.

Reviewed the model output report in Appendix F.

Kay Cleary attested that modifications, adjustments, assumptions, inputs, defaults, and treatment of missing values are actuarially sound.

Documentation reviewed:

- 2012 FHCF and Form A-4B Exposure Data Module (EDM) Development Overview, Version 3.3, September 6, 2016.

A-2 Event Definition

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Discussed the definitions of landfalling and bypassing events.

Reviewed an example Analysis Summary Report illustrating the perils that can be used in a calculation of the modeled losses.

A-3 Coverages

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

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

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

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

Audit

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

Pre-Visit Letter

31. A-3, Disclosure 4, page 133: Explain with examples the difference between direct and indirect loss.

Verified: YES

Professional Team Comments:

Discussed definitions of direct and indirect loss used by the modeler.

Kay Cleary attested that the methods used in the development of building, appurtenant structure, contents, and time element loss costs are actuarially sound.

A-4 Modeled Loss Cost and Probable Maximum Loss Considerations

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

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

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

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

32. A-4, Disclosure 1, page 134: Provide documentation explaining the relationships that could hold between OEP and AEP exceedance curves and the underlying event frequency and event severity distribution.

Verified: YES

Professional Team Comments:

Reviewed the procedure to generate annual occurrence exceedance curves and annual aggregate exceedance curves.

Reviewed flowchart for producing exceedance probability curves.

Reviewed graphical comparison of the annual aggregate exceedance probability curves and annual occurrence exceedance probability curves.

Documentation reviewed:

- *The Computation of Aggregate Loss Distributions*, John P. Robertson, Proceedings of the Casualty Actuarial Society, 1992, Volume LXXIX.
- RMS Exceedance Probability Methodology, October 31, 2003.
- RMS Tail Conditional Expectation Methodology, May 2004.

Discussed the data and methods used in the calculation of demand surge on personal and commercial residential losses. Discussed no change in the demand surge methodology.

Reviewed the demand surge curves for building, contents, and time element losses. Discussed process and timing for reviewing and updating demand surge curves.

Discussed the use of trending to account for inflation and in adjusting model estimates for comparison purposes with industry estimates of different vintages.

A-5 Policy Conditions

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

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

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

Audit

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

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

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

4. Treatment of annual deductibles will be reviewed.

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

Verified: YES

Professional Team Comments:

Discussed that the model does not make any adjustments for insurance-to-value.

Discussed the review of claims data for consistency with policy conditions and reasonableness.

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

Reviewed the flowchart and source code for application of annual deductible ratios.

Reviewed plots of deductible sensitivities in Form A-6 comparing the current to the previous submission.

Kay Cleary attested that the application of deductibles and policy limits is actuarially sound.

A-6 Loss Outputs and Logical Relationships to Risk

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

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

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

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

Pre-Visit Letter

33. A-6, Disclosure 14, page 141: Provide an example illustrating the effects of coinsurance on commercial residential loss costs.

34. Form A-1, pages 206-208: Identify ZIP Codes with larger than expected loss costs relative to their more coastal or southerly neighboring ZIP Codes (e.g., southeast shore of Lake Okeechobee, interior ZIP Codes in Broward and Palm Beach counties, and interior ZIP Codes in Hillsborough and Hernando/Citrus counties) and justify the results.

35. Form A-3, Figure 77, page 233: Explain why ZIP Code 33865, which is crossed by the track of Hurricane Charley (2004) produces zero loss (white color).

36. Form A-3, page 237: Provide Figure 81 with tracks.

37. Form A-4, 0% Deductible, page 241: Calhoun County has a low frame renters loss cost value of 0.067. For this same ZIP Code, provide the masonry renters loss cost value.

38. Form A-4, 0% Deductible, page 242: Duval County has a high masonry owners loss cost value of 3.075. For this same ZIP Code, provide the frame owners loss cost value.

39. Form A-4, 0% Deductible, page 242: Escambia County has a low frame renters loss cost value of 0.110. For this same ZIP Code, provide the masonry renters loss cost value.

40. Form A-4, 0% Deductible, page 243: Hardee County has commercial-residential exposure in two ZIP Codes (33873, 33880) while the results in Form A-4 (0.387 for LOW, AVERAGE, and HIGH) suggest that only one ZIP Code is being used. Explain.

41. Form A-4, pages 241-254: There are six counties (Columbia, Franklin, Gulf, Hendry, Holmes, and Washington) that appear to have a single ZIP Code populated with all of the county's commercial residential exposure in the file generated from "hplm2012c.exe." Explain the three distinct values for LOW, AVERAGE and HIGH for each county (both zero deductible and specified deductibles).

42. Form A-4, 0% Deductible, page 244: Lafayette County has masonry construction in two of its four ZIP Codes (32013 with 1 row, $370,999 total insured value; 32066 with 33 rows, $80,648,944 total insured value). Explain the averaging and weighting scheme used to arrive at the reported masonry value, supplying additional digits as necessary.

43. Form A-4, 0% Deductible, page 244: Consider Lafayette County for manufactured homes. Again two ZIP Codes only contain exposure with one ZIP Code dominating. Explain the averaging and weighting scheme used to arrive at the reported manufactured homes value, supplying additional digits as necessary.

44. Form A-5, page 257: Explain the double-digit changes in Tables 39 and 40.

45. Form A-5, Figure 87, page 263: Explain the Dixie and Levy counties contrasting values.

46. Form A-5, Figure 88, page 264: Explain the Union County outlier.

47. Form A-5, Figure 89, page 265: Explain the Gulf and Franklin counties contrasting values.

48. Form A-7, pages 268-269: Explain the large changes for Frame Renters, Frame Condo Unit, Masonry Renters, and Masonry Condo Unit for the North Region.

49. Form A-7, page 270: Explain the large changes in Frame Renters and Frame Condo Unit.

50. Form A-7, Table 44, pages 271-272: Explain the large changes in Coverages C and D for Renters and Condo Units.

51. Form A-7, Table 45, page 273: Explain the large changes for Renters and Manufactured Homes.

52. Form A-7, Table 46, page 275: Explain the large changes for Renters and Manufactured Homes.

53. Form A-7, Table 48, page 277: Explain the large changes for Renters.

54. Form A-8, page 279: Explain Figure 90. Provide an expanded graph above $120 billion.

55. Form A-8, Tables 50 & 51, page 282: Provide the first and second moments of the Annual Aggregate and Annual Occurrence distributions underlying the tables. Also, provide the first and second moments of the frequency and severity distributions underlying the PMLs shown in Parts B and C.

56. Form A-8, page 282: Clarify the FHCF exposure used in Parts B and C.

Verified: YES

Professional Team Comments:

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

Discussed the variation in loss costs given in Form A-1 for the southeast shore of Lake Okeechobee, interior ZIP Codes in Broward and Palm Beach counties, and interior ZIP Codes in Hillsborough and Hernando/Citrus counties. Discussed the effect of water surface cover and inventory region assignments on the losses.

Reviewed losses and exposure in ZIP Code 33865 given in Form A-3.

Reviewed Figure 81, Form A-3, with the 2004 storm tracks superimposed on the map.

Reviewed the differences in loss cost results for renters frame and renters masonry for Calhoun and Escambia counties and for masonry owners and frame owners for Duval County.

Reviewed the computed weighted average for commercial residential losses for Hardee County.

Reviewed the low, average, and high values for Columbia, Franklin, Gulf, Hendry, Holmes, and Washington counties.

Discussed the modeler's process for checking the output range results.

Reviewed the averaging and weighting scheme used to derive Lafayette County masonry and manufactured homes loss costs in Form A-4.

Discussed the changes in Forms A-5 and A-7 relative to the previous submission.

Reviewed the changes in Form A-5 for Dixie and Levy counties driven by the land use land cover (LULC) update.

Reviewed the changes in Form A-5 for Union, Alachua, Gulf, and Franklin counties driven by the vulnerability updates and the underlying exposure.

Reviewed comparison of the current and previous mean damage ratios for masonry low rise pre-1994 and condo masonry post 2003.

Reviewed the changes in Form A-7 for frame renters, frame condo unit, masonry renters, and masonry condo unit in the North Region, for Coverages C and D for renters and condo units, and for renters and manufactured homes driven by the change in multi-family dwelling vulnerability updates.

Reviewed an expanded graph for Figure 90 above $120 billion consistent with Form A-8, Part A.

Reviewed the method for calculating the statistics of the annual aggregate and annual occurrence distributions underlying Form A-8, including the frequency and severity distributions underlying the probable maximum loss levels in Parts B and C.

Discussed that the 2012 FHCF exposure data were used to complete Parts B and C of Form A-8. In the original submission, Tables 50 and 51 were incorrectly labeled as using the 2007 FHCF exposure data. Reviewed a modified editorial checklist to prevent this type of error from reoccurring.

Kay Cleary attested that the methods, data, and assumptions used in the estimation of probable maximum loss levels are actuarially sound.

Reviewed the hurricane associated with the Top Event in Form A-8.

Reviewed in detail Form A-6.

COMPUTER/INFORMATION STANDARDS – Paul Fishwick, Leader

CI-1 Documentation

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

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

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

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

57. CI-1.B, page 142: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 (pages 33-35) by demonstrating individual table item compliance with Computer/Information Standards CI-1 through CI-7.

Verified: YES

Professional Team Comments:

Discussed no change in the modeler's method for creating and maintaining documentation.

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

CI-2 Requirements

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

Audit

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

Pre-Visit Letter

58. CI-2, pages 143-144: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5 (pages 33-35).

Verified: YES

Professional Team Comments:

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

CI-3 Model Architecture and Component Design

The modeling organization shall maintain and document (1) detailed control and data flowcharts and interface specifications for each software component, (2) schema definitions for each database and data file, (3) flowcharts illustrating model-related flow of information and its processing by modeling organization personnel or consultants, and (4) system model representations associated with (1)-(3). Documentation shall be to the level of components that make significant contributions to the model output.

Audit

1. The following will be reviewed:
   a. Detailed control and data flowcharts, completely and sufficiently labeled for each component,
   b. Interface specifications for all components in the model,
   c. Documentation for schemas for all data files, along with field type definitions,
   d. Each network flowchart including components, sub-component flowcharts, arcs, and labels, and
   e. Flowcharts illustrating model-related information flow among modeling organization personnel or consultants (e.g., BPMN, UML, SysML, or equivalent technique including a modeling organization internal standard).

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

Verified: YES

Professional Team Comments:

Discussed three flowcharts presented by the modeler and subsequently revised.

Discussed the need for the modeler to pay special attention to section (g.) in the Acceptability Process (Report of Activities, page 48) to achieve consistency and accuracy in flowchart construction.

Reviewed new RMS Flow Diagram Standards for data and control flow diagrams.

Reviewed revised Form A-4 data flow diagram.

Reviewed revised RiskLink data flow diagram.

Reviewed flowchart for construction of historical windfields from HURDAT2.

Reviewed flowchart for land use land cover update methodology.

Reviewed flowchart for analyzing multi-family dwelling claims data.

Reviewed flowchart for vulnerability curve selection.

Reviewed flowchart for development of contents vulnerability functions.

Reviewed flowchart for producing exceedance probability curves.

Reviewed flowchart for application of annual deductible ratios.

CI-4 Implementation*

*(*Significant Revision)*

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

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

Verified: YES

Professional Team Comments:

Reviewed scripts for the generation of actuarial forms.

Reviewed RiskLink 17.0 Component Methodology: CM1700_003 NAHU Long Term Rate Updates.

Reviewed implementation of the multi-family dwelling claims data analysis.

Reviewed implementation of annual deductibles.

Reviewed the methodology for selecting vulnerability curves when input data are conflicting. Reviewed flowchart for vulnerability curve selection and its implementation in the source code.

CI-5 Verification

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

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

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

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

6. The response to Disclosure 1 will be reviewed.

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

Pre-Visit Letter

59. CI-5, pages 149-151: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5 (pages 33-35).

Verified: YES

Professional Team Comments:

Reviewed the model test plan for hazard datafile checks.

Discussed the process and interaction of modeler personnel for development of test plans.

Reviewed the model test plan for updates to the vulnerability module.

Reviewed the Model Certification Test Plan/Results North Atlantic Hurricane (NAHU) Model for RiskLink 17.0.

CI-6 Model Maintenance and Revision

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

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

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

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

Audit

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

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

3. Portions of the code, not necessarily related to recent changes in the model, will be reviewed.
4. The tracking software will be reviewed and checked for the ability to track date and time.

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

Pre-Visit Letter

60. CI-6.D, page 153: 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 policy for model revision and management has not changed.

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

CI-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed that there have not been any changes to the written security policy since the previously accepted model.

Discussed that there were no security breaches since the previously accepted model.