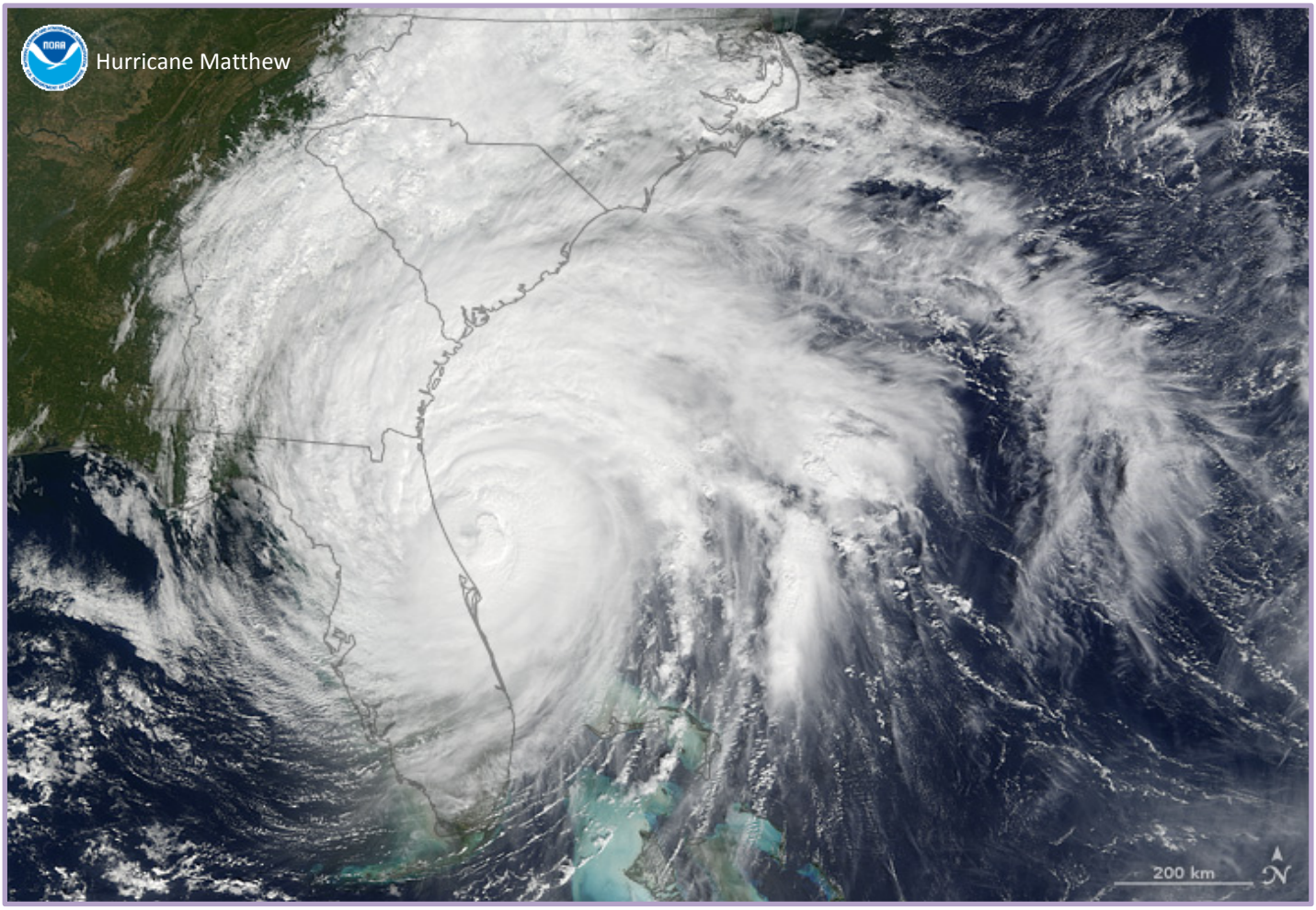
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report

2015 Standards



Applied Research Associates, Inc.

On-Site Review

February 6-8, 2017

On February 6-8, 2017, the Professional Team visited Applied Research Associates, Inc. (ARA) in Raleigh, North Carolina. The following individuals participated in the review.

ARA
Francis M. Lavelle, Ph.D., P.E., Vice President
Laura Maxwell, FCAS, MAAA, Actuarial Consultant (via phone)
David Mizzen, M.S.C.E., Staff Scientist
Lauren Mudd, Ph.D., P.E., Staff Engineer
Peter J. Vickery, Ph.D., P.E., Principal Engineer

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

The review began with introductions and an overview of the audit process by the Professional Team. ARA provided a detailed presentation of the following changes made in HurLoss Version 8.0.a:

- Correction of errors related to the GIS processing of water areas adjacent to coastal counties and in the vintage of the ZIP Code polygons used to compute average ZIP Code surface roughness corrected in HurLoss version 7.0.b.
- Hurricane storm set updated to include storm data and climatological data from the 2014 and 2015 hurricane seasons.
- ZIP Codes updated to use June 2016 data and change in centroid methodology.
- Methodology for estimating average ZIP Code surface roughness modified to account for the effects of bodies of water in a manner more closely aligned to the methodology for estimating surface roughness at individually geocoded locations.

The overall impact of the model changes is an increase of 0.8% in statewide zero deductible average annual loss using the 2012 FHCF exposure data.

ARA reviewed with the Professional Team the terrain corrections made in HurLoss 7.0.b discussing the surface roughness background information, the changes in surface roughness from HurLoss 7.0.a to 7.0.b, the changes in losses from 7.0.a to 7.0.b, and the corrective actions implemented.

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

1. Change in ZIP Code centroid methodology.
2. Subset of analyses on Hurricane King (1950), Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).
3. Justification for the construction classes and characteristics used in the model.
4. 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.
5. Methodology for reinforced masonry and the exposure data and its consistency with the prevailing Florida Building Code and code enforcement.

6. Method for excluding storm surge losses from the modeled losses.
7. Detailed information and discussion of Form V-3 as specified on page 55 of the *Report of Activities*, including changes made during the on-site review.
8. Detailed information and discussion of relativities in Form A-6 as specified on pages 55-56 of the *Report of Activities*, including changes made during the on-site review.

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 January 4, 2017 revised submission provided in response to the deficiencies.

- Page 27, G-1 Disclosure 5.A – model change (3) revised to include changes in ZIP Code centroid methodology
- Page 79, S-5 and Disclosure 1 – text referencing information previously presented to the Professional Team removed
- Page 80, S-5 Disclosure 1 – Figure 23 revised
- Page 84, V-1.D – response revised for clarification
- Page 87, V-1 Disclosure 8 – revised to correct Disclosure 9 referenced
- Page 89, V-2.B – revised to correct V-2.1 referenced
- Page 89, V-2.D – revised to correct Disclosure 7 referenced
- Page 89, V-2 Disclosure 2 – revised to correct Disclosure 4 referenced
- Page 94, V-2 Disclosure 10 – revised to correct Disclosure 11 referenced
- Page 97, A-1.B – revised to correct V-1 Disclosure 3 referenced
- Page 105, A-2 Disclosures 1 & 2 – revised for clarification
- Page 144, Form G-5 – revised to use correct expert certification form for the Actuarial Standards
- Page 165, Form S-2 – revised to correct standard deviation values
- Page 190, Form V-2 – revised to correct reference structure details as given in the *Report of Activities*

Report on Deficiencies

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

1. Standard G-1, Disclosure 4 (Pages 137-142)
   Response is incomplete as Florida Building Code references are not included in the vulnerability references.

2. Standard G-1, Disclosure 5 (page 31)
   Comparisons in the submission are to be between the current submitted Version 8.0.a and the currently accepted model Version 7.0.b.

3. Standard G-2, Disclosure 3.B (page 47)
   Response is incomplete as documentation of the independent actuarial review is not given.

4. Form G-5 (page 150)
   Response is non-responsive as the model version does not correspond to the current submission being reviewed.

5. Standard M-2 (page 58)
   Response is unclear as the year ranges for SST and T_0 are inconsistent with the response to Standard G-1, Disclosure 5.

6. Form M-1.E (page 154)
   Response is non-responsive as the list of storms does not reflect changes relevant to Florida in HURDAT2 since the previously accepted model version.

7. Form M-2 (pages 160-164)
   Response is non-responsive as contour plots are not given in Figures 33, 34, and 35.

8. Standard S-1, Disclosure 1 (page 76)
   Response is incomplete as statistical techniques used for estimation and specific goodness-of-fit tests applied along with corresponding *p*-values are not given.

9. Standard S-1, Disclosure 4 (page 77)
   Response is incomplete as assessment of uncertainty in probable maximum loss levels is not given.

10. Standard S-5, Disclosure 1 (page 86)
    Response is incomplete as the loss projections generated for personal and commercial residential losses are not given separately.

11. Standard V-1, Disclosure 4 (page 92)
    Response is incomplete as a description of assumptions is not given.

12. Standard V-1, Disclosure 8 (page 94)
    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.

13. Standard V-1, Disclosure 9 (page 94)
    Response is incomplete as assumptions, data, methods, and processes relating to when some building characteristics are unknown are not given.

14. Standard V-3.A (page 102)
    Response is incomplete as the impact of mitigation measures on associated uncertainties is not given.

15. Standard A-1, Disclosure 1 (page 104)
    Response is incomplete as a sample calculation for determining the property value is not given.

16. Standard A-1, Disclosure 2 (page 105)
    Response is incomplete as a sample calculation for determining the amount of depreciation and the actual cash value losses is not given.

17. Standard A-1, Disclosure 5 (page 105)
    Response is incomplete as a copy of the input form is not given.

18. Form A-8 (pages 302-303)
    Response is unclear as most of the conditional tail expectation values are less than the estimated loss levels.

Discussion on Inquiries

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

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

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

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

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

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

The purpose of the pre-visit letter is to outline specific issues unique to the modeler's submission, and to identify lines of inquiry to be followed during the on-site review to allow adequate preparation by the modeler. Aside from due diligence with respect to the full submission, various questions that the Professional Team is certain to ask the modeler during the on-site review are provided in this letter. This letter does not preclude the Professional Team from asking for additional information during the on-site review that is not given below or discussed during an upcoming conference call that will be held

if requested by the modeler. One goal of the potential conference call is to address modeler questions related to this letter or other matters pertaining to the on-site review. The overall intent is to expedite the on-site review and to avoid last minute preparations that could just as easily have been handled earlier.

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

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

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

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

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

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

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

The pre-visit comments are grouped by standards sections.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Model and Its Implementation*

*(*Significant Revision)*

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

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

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

Audit

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

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

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

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

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

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

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

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

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

Pre-Visit Letter

1. G-1, Disclosure 5.C, pages 33-37: Describe changes to response in light of error discovery. Explain the November 21, 2016 submission of revised material.

2. G-1, Disclosure 5.C, page 34: Figure 4 seems very "blotchy" in that neighboring counties have considerably different percentage changes. Examples include the counties adjacent to Jackson County and the neighboring counties to Charlotte County. Provide an explanation.

3. G-1, Disclosure 5.C, Figure 4, page 34: Explain zero change in Broward County. Explain high increase in Calhoun County next to high decrease in Jackson County.

4. G-1, Disclosure 5.C, Figure 5, page 35: Identify the ZIP Codes that lead to the abrupt changes in adjacent counties (e.g., Bradford, Flagler, Liberty). The updated ZIP Code centroids will be reviewed in detail.

5. G-1, Disclosure 5.C, Figure 5, page 35: Explain zero change in Orange and Osceola counties. Explain the sharp decrease in Liberty County next to the sharp increases in the neighboring Gulf counties.

6. G-1, Disclosure 5.C, Figure 6, page 36: Explain the relatively large changes in the panhandle counties (Santa Rosa, Okaloosa, Walton), Nassau, St. Johns, and Monroe counties.

7. G-1, Disclosure 5.C, Figure 6, page 36: Explain zero change in Calhoun and Polk counties. Explain the sharp increase in Monroe County.

8. G-1, Disclosure 5.C, page 37: Provide the individual changes that contribute to the overall changes for the dark red and dark blue counties in Figure 7 including Santa Rosa, Orange, and Monroe counties.

Verified: YES

Professional Team Comments:

Reviewed in detail the model changes provided in disclosure 5.

Reviewed graphical depictions of 20, 50, 100, and 250-year return period windspeeds for the model updates to the historical event set and ZIP Code centroids.

Reviewed the ZIP Code surface roughness used for non-geocoded risks change in methodology to refine the effects of bodies of water.

Reviewed map and scatter plot of the change in ZIP Code surface roughness between HurLoss 7.0.b and 8.0.a.

Reviewed the corrective actions and tests added to prevent a recurrence of the errors detected in HurLoss 7.0.a which were corrected in HurLoss 7.0.b.

Discussed percentage changes in Figure 4 for Broward, Calhoun, and Jackson counties.

Reviewed the ZIP Code centroid movements and the percentage changes in Figure 5 for Bradford, Flagler, and Liberty counties.

Reviewed the percentage changes in Figure 5 for Bay, Gulf, Franklin, Wakulla, Orange, and Osceola counties.

Reviewed the percentage changes in Figure 6 for Santa Rosa, Okaloosa, Walton, Nassau, St. Johns, and Monroe counties. Discussed the effect of the ZIP Code methodology change on these counties.

Reviewed percentage changes in Figure 6 carried out to three decimal places for Calhoun, Polk, and Monroe counties.

Reviewed the breakdown of individual changes contributing to the overall percentage changes in Figure 7 for Gulf, Highlands, Leon, Monroe, Nassau, Orange, Osceola, Santa Rosa, and Wakulla counties.

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

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

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

Audit

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

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

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

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

Pre-Visit Letter

9. G-2, Disclosure 3, page 47: Provide results of the actuarial review.

Verified: YES

Professional Team Comments:

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

Discussed with Laura Maxwell, external actuarial consultant, her review of the model, the initial November 2016 submission, and the changes in the January 4, 2017 submission.

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 the ZIP Code centroid updates using June 2016 population weighted centroids.

Discussed the change to a higher resolution for the data underlying ZIP Code centroids.

Reviewed the methodology for assigning the ZIP Code centroids to wind grids.

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

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.

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

10. M-1, page 57: Changes in the Base Hurricane Storm Set will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the hurricane event set updated to include storm data and climatological data from the 2014 and 2015 hurricane seasons.

Discussed the update to the storm genesis points and the negative binomial distribution for number of storms simulated per year.

Reviewed plots of the storm track changes for the following storms impacting Florida:

- NoName03 (1903)
- NoName06 (1921) [Tampa Bay]
- NoName05 (1924)
- NoName10 (1924)
- NoName01 (1926)
- NoName02 (1929)
- NoName03 (1932)
- NoName05 (1933)
- NoName08 (1933)
- NoName11 (1933)
- NoName03 (1934)
- NoName03 (1935) [Labor Day]
- NoName05 (1936)
- NoName02 (1939)
- Baker (1950)
- Florence (1953)
- Camille (1969)
- Georges (1998)
- Irene (1999)

Reviewed changed storm parameters for each event.

Discussed the consistency of Forms M-1 and S-1 and the relationship to the frequency distribution underlying the exceedance probability curves.

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.

Pre-Visit Letter

11. M-2, page 58: The process for calculating windspeed at any height in the model will be reviewed. Provide a flowchart for the process.

Verified: YES

Professional Team Comments:

Reviewed the process and methodology for calculating windspeed at any height.

Reviewed implementation of methodology for calculating windspeed at any height.

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 64: The variability in the updated SST, tropopause temperature, and shear databases will be compared with observed hurricane activity in these years.

Verified: YES

Professional Team Comments:

Reviewed the difference in landfalling and by-passing hurricanes by category and by region from the previous submission.

Reviewed the time series of historical sea surface temperature, tropopause temperature, and wind shear parameters updated through 2015.

Reviewed impact of historical sea surface temperature and tropopause temperature on potential intensity time series for the period 1949 to 2015.

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 66: 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.

14. M-4, Disclosure 10, page 68: Detailed analyses of Hurricane King (1950), Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005) will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the process for converting land use and land cover data into a spatial distribution of roughness coefficients.

Reviewed the surface roughness methodology flowchart.

Reviewed the change in ZIP Code average roughness in HurLoss 8.0.a.

Reviewed changes to Hurricane King (1950) storm track and comparison of modeled versus historical observed windspeeds to those given in the previous submission.

Reviewed time series comparisons of the modeled versus observed station data for peak gust windspeeds, mean windspeeds, wind direction, and pressure along the storm tracks for Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).

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:

Reviewed detailed comparisons of observed (station) and modeled windspeed (average and gust), surface pressure, and wind direction.

Discussed updated method for fetch calculation at landfall based on wind direction in the coastal zone just offshore and on land.

Discussed diagnostics of the impact of these fetch calculations on upstream roughness and surface wind.

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 74: Methods (including any software) used in verifying logical relationships among hurricane characteristics will be reviewed.

Verified: YES

Professional Team Comments:

Discussed statistical tests used in evaluating logical relationships. Discussed the use of MATLAB in support of statistical testing.

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

16. S-1, Disclosure 1, page 76: Provide test descriptions (data sets used) and *p*-values for all updated goodness-of-fit tests. Explain the adjusted *p*-values in light of the updates.

17. S-1, Disclosure 3, page 77: Explain how company data from Hurricane Hugo (1989) helped to validate the Florida model.

18. Form S-2, page 170: Explain the differences between the mean values given in Form S-2, Part B and Form A-8, Part A, page 300.

Verified: YES

Professional Team Comments:

Discussed the underlying data used and the *p*-values for the goodness-of-fit tests associated with Form S-3.

Reviewed the cumulative distribution functions for the modeled Holland B parameter and Radius of Maximum Winds at landfall in Florida, Georgia, Alabama, and Mississippi.

Discussed the use of Hurricane Hugo (1989) for validation.

Discussed the reason for the rounding differences between the mean values given in Form S-2 and Form A-8. Reviewed a revised Form S-2 to correct the standard deviation values in Part B.

Reviewed cumulative distribution function plots and results of statistical tests on various hurricane characteristics including translational velocity, heading at landfall, landfall occurrence rates and central pressure at landfall by state, region and segment as well as central pressure at landfall versus return period. Underlying data were based on storms with at least hurricane windspeed at landfall. Reviewed a parallel set of tests for storms of hurricane strength as determined by central pressure.

Reproduced various summary statistics using modeler datasets.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed no changes in model methodology from the previous submission.

Verified that no new sensitivity tests were required.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed no changes in model methodology from the previous submission.

Verified that no new uncertainty tests were required.

S-4 County Level Aggregation

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

Audit

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

Verified: YES

Professional Team Comments:

Discussed the change from 300,000 years of simulation to 250,000 years for stochastic convergence.

S-5 Replication of Known Hurricane Losses

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

Audit

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

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

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

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

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

Pre-Visit Letter

19. S-5, page 85: Describe updates made in this section.

20. S-5, page 85: Explain why demand surge is not included in the modeled losses.

Verified: YES

Professional Team Comments:

Discussed the use of the new ZIP Code centroids and ZIP Code surface roughness values for the current comparisons of modeled and observed losses.

Discussed the reasons for the exclusion of demand surge in the modeled losses comparisons.

Reviewed comparison of modeled and actual losses as a function of peak gust windspeed in open terrain for personal residential and commercial residential losses.

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.

Pre-Visit Letter

21. Form S-5, page 180: Explain the opposite direction in change for historical and modeled losses.

Verified: YES

Professional Team Comments:

Discussed historical losses being lower than modeled losses in Form S-5 due to updates in historical event wind fields and two additional years of no historical losses.

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

22. V-1, Disclosure 7, page 94: Explain the impact of Florida Building Code, especially the recent vintages, on building vulnerability.

Verified: YES

Professional Team Comments:

Discussed the review of Florida Building Code versions and ASCE-7 design wind load standards and the application of the building codes and their enforcement in development of the building vulnerability functions.

Discussed no change in the building vulnerability functions.

Discussed masonry construction classes, including unreinforced masonry, reinforced masonry, unknown masonry and masonry veneer construction classes.

Discussed the treatment of reinforced masonry. The model can address both reinforced and unreinforced masonry construction. The base vulnerability function is used for reinforced masonry and unknown masonry classes. If the building is specified as unreinforced masonry, a weaker vulnerability function is applied.

Discussed no change in the minimum windspeed at which damage occurs.

Discussed the process for completing Form V-1 and the behavior of loss ratios in comparison with the previous submission.

Documentation reviewed:

- Twisdale, L.A., Vickery, P.J., Chen, J., Wadhera, D. (2007). "Evaluation and Report on the Insurability of Attached and Free Standing Structures," Applied Research Associates, Raleigh, North Carolina, April.

Reviewed comparison of modeled and actual building losses as a function of peak gust windspeed for Hurricane Charley (2004).

Discussed the percentage of damage at which the model assumes a total loss.

V-2 Derivation of Contents and Time Element Vulnerability Functions

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

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

Pre-Visit Letter

23. V-2, Disclosures 8 & 9, page 100: Explain the responses given in light of V-1.D on page 91.

Verified: YES

Professional Team Comments:

Reviewed and discussed the revised Figure 23 with axes scales given.

Reviewed and discussed Figures 26 and 28 with axes scales given.

Discussed contents and time element losses as function of the building loss level.

Reviewed the process and flowcharts for calculating ALE and contents losses.

Reviewed comparison of modeled and actual contents losses as a function of building damage for Hurricane Charley (2004).

Reviewed comparison of modeled and actual ALE losses as a function of building damage for Hurricane Charley (2004).

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

24. V-3, Disclosure 1, page 102: Discuss the "N/A" response in spite of the introduction of ASTM D3161 Class F and ASTM D7158 Class G and H shingles for completing Forms V-2 and V-3.

Verified: YES

Professional Team Comments:

Discussed the handling of the three classes of shingles in Forms V-2 and V-3. ARA stated there is no empirical evidence to support the fact that these shingles are any better than the FBC shingles and that there is still some uncertainty as to whether or not the FBC shingles performed better in the 2004 and 2005 storms because they were better or because they were new.

Reviewed revised Trade Secret Form V-3 in detail and confirmed consistency with Form V-2.

Reviewed the results in Form V-3 with the previous submission. Discussed the changes relative to the previous submission due to the changes in the surface roughness factors and moving to a better rated shingle and roof covering in the reference structure.

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 following items prepared by Laura Maxwell, ARA's external actuarial consultant:

- Ms. Maxwell's experience and qualifications (currently with Pinnacle)
- Letter report dated November 10, 2016 (Appendix C of the January 4, 2017 submission)
- Her opinion as to actuarial soundness as specified in Standards A-1, A-3, A-4, A-5, and A-6
- Her review of actuarial Forms A-4 and A-6
- The process and limitations of her actuarial review.

Discussed the assumptions and defaults for ARA's proprietary building stock model associated with construction type, year built, and occupancy for unknown, incompletely specified secondary risk and other characteristics.

Discussed how to determine hurricane losses for a portfolio of actual cash value (ACV) risks.

Discussed ARA's use of the UNICEDE®/px data exchange format developed by AIR for data input.

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.

Pre-Visit Letter

25. A-2, Disclosure 2, page 109: Disclose all the triggers for Loss of Use coverage associated with the hurricane peril. Compare to response provided to Standard A-3, Disclosure 4 (page 111) in reference of infrastructure damage.

Verified: YES

Professional Team Comments:

Discussed damage from model generated landfalling and by-passing storms in the calculation of loss costs and probable maximum loss levels.

Discussed time element triggers for loss of use coverage.

Discussed criteria applied to stochastic storms to identify by-passing hurricanes.

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

26. A-3.D, page 110: Explain the ARA time element loss model.

27. A-3, Disclosures 1-4, pages 110-111: Explain features pertaining to commercial residential properties.

28. A-3, Disclosure 4, page 111: Explain how the "model allows for time element losses to be incurred due to indirect causes such as infrastructure damage."

Verified: YES

Professional Team Comments:

Discussed with Laura Maxwell her review and attestation that the methods used in the development of building, appurtenant structure, contents, and time element loss costs are actuarially sound.

Discussed the time element loss model that is primarily based on the distribution of time required to repair or replace the direct physical damage to the building to bring it back to its pre-storm level of functionality.

Discussed similarities in the methodologies used in the calculation of hurricane loss costs for buildings, appurtenant structures, contents, and time element for personal and commercial residential properties.

Discussed the process allowing time element losses to be incurred due to indirect causes such as damage to the infrastructure.

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

29. A-4, Disclosure 3, page 113: Explain the multiplicative demand surge factor and how it is applied to modeled risks.

Verified: YES

Professional Team Comments:

Discussed with Laura Maxwell the process for ensuring that loss cost projections do not include any prohibited items.

Reviewed the multiplicative demand surge factor and how ARA applies it in its hurricane loss model.

Discussed the ongoing need for an expansion of the actuarial bibliography.

A-5 Policy Conditions

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

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

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

Audit

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

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

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

4. Treatment of annual deductibles will be reviewed.

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

Pre-Visit Letter

30. A-5, Disclosure 3, page 115: Explain the calculation of the $1,712 Loss Net of Deductible shown in Table 2. Generalize the explanation to illustrate the treatment of deductibles and policy limits in the model.

Verified: YES

Professional Team Comments:

Discussed with Laura Maxwell her review and attestation that the application of deductibles and policy limits are actuarially sound.

Discussed the order of applying deductibles and policy limits in calculating the loss costs.

Reviewed the expected loss calculations and variables in the code.

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

31. A-6, Disclosure 11, page 119: Explain the response "N/A."

32. A-6, Disclosure 14, page 120: Provide an example illustrating the effects of coinsurance on commercial residential loss costs.

33. Form A-4.G, page 247: Explain why "per diem is not used in producing loss costs for Coverage D (ALE)."

34. Form A-4.F, page 247: Explain the lack of apparent anomalies.

35. Form A-4, 0% Deductible, page 260: Bay County has a low frame owners loss cost value of 0.675. For this same ZIP Code, provide the masonry owners loss cost value.

36. Form A-4, 0% Deductible, page 263: Santa Rosa County has a low frame owners loss cost value of 1.505. For this same ZIP Code, provide the masonry owners loss cost value.

37. Form A-4, 0% Deductible, page 263: Orange County has a high masonry renters loss cost value of 0.411. For this same ZIP Code, provide the frame renters loss cost value.

38. Form A-4, 0% Deductible, page 261: Provide details on the computation of the weighted average for commercial residential losses for Hardee County, having commercial residential exposures in two ZIP Codes (as evidenced from data developed from the aggregate residential exposure data in the file "hlpm2012c.exe").

39. Form A-4, pages 260-269: There are five counties (Columbia, Franklin, Gulf, Hendry, and Washington) that appear to have a single ZIP Code populated with some commercial residential exposure in the file generated from "hplm2012c.exe." Explain the three distinct values for LOW, AVERAGE, and HIGH for each county (both $0 deductible and specified deductibles). Explain how similar situations were handled for other exposure types in other counties.

40. Form A-4, 0% Deductible, page 262: 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.

41. Form A-4, 0% Deductible, page 262: 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.

42. Form A-5, page 273: Discuss why many of the changes shown are large.

43. Form A-7, pages 284-296: Discuss why many of the changes shown are large.

44. Form A-8, Figure 58, page 301: Provide an expanded graph above $120 billion.

45. Form A-8, pages 302-303: Explain the observation that the relationship between Estimated Loss Levels in Parts B and C is relatively constant across Return Period.

46. Form A-8, pages 302-303: 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.

Verified: YES

Professional Team Comments:

Reviewed the process for calculating ALE losses.

Discussed with Laura Maxwell her review of the results reported in Form A-6.

Discussed the Building Code/Enforcement (Year Built) Sensitivity results in Form A-6.

Discussed with Laura Maxwell her review and attestation that the modeled probable maximum loss levels are actuarially sound.

Discussed the Deductibles Sensitivity, Building Strength Sensitivity, Condo Unit Floor Sensitivity, and Number of Stories Sensitivity results in Form A-6.

Discussed modeling of roof age and the effect of roof covering in Form A-6 results.

Reviewed construction characteristics for the weak, medium, and strong frame owners buildings in the Building Strength Sensitivity of Form A-6.

Discussed the difference in values reported on Form A-8 and Form S-2 attributable to maintaining enough significant digits.

Reviewed the coinsurance methodology. Reviewed an example of coinsurance on commercial residential loss costs.

Discussed the assumption used for per diem in producing Coverage D (ALE) loss costs.

Discussed ARA's perspective on anomalies in the loss cost results provided in Form A-4.

Reviewed the differences in loss cost results for frame owners and masonry owners for Bay and Santa Rosa counties, and for masonry renters and frame renters for Orange County.

Reviewed the computation of the weighted average for commercial residential losses for Hardee County.

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

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 from the previous submission.

Reviewed an expanded graph for Figure 58 above $120 billion including both annual aggregate and annual occurrence exceedance probabilities.

Discussed the relationship between estimated loss levels in Form A-8, Parts B and C across return periods.

Reviewed the calculated 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.

Reviewed the apparent zero loss costs for renters as shown in Form A-4.

COMPUTER/INFORMATION STANDARDS – Paul Fishwick, Leader

CI-1 Documentation

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

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

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

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

47. CI-1.B, page 122: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 (pages 31-37) 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.

Reviewed enhanced QA procedures for form processing. All FORTRAN codes used to post process HurLoss outputs for creating submission forms will be independently verified via comparisons to sample calculations. At least one verification will be performed for each policy type or calculation type (e.g., EP values, mean, minimum, maximum, standard deviation, etc.). All tools used to generate input files will be verified by comparing the QA outputs from HurLoss to the current year's specifications and data provided with the *Report of Activities*. These procedures will be implemented for the submission under the 2017 Standards.

CI-2 Requirements

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

Audit

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

Pre-Visit Letter

48. CI-2, page 123: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5 (pages 31-37).

Verified: YES

Professional Team Comments:

Reviewed requirements documentation for each model change identified in 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:

Reviewed flowchart specifying the process for calculating windspeed at any height in the model.

Reviewed flowchart specifying the process for calculating surface roughness.

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.

Pre-Visit Letter

49. CI-4.D, page 125: Provide description of work relevant to the Computer/Information Standards identified in the previous model audit. The Professional Team reviewed Standard C-4.D for the density of the modeler's source code. Quoting from the Professional Team report: "Discussed that in some parts of the model, the number of comments and comment density was insufficient for maintaining robustness of the software and asked the modeler to come up with an incremental long-term plan to address this issue. Reviewed the new plan documenting legacy code used in Lifesim_Wind with comments created by the modeler. This approach will result in changes to be finished by June 1, 2016."

Verified: YES

Professional Team Comments:

Discussed the ongoing commitment by the modeler to "clean up" legacy code through 1) more efficient and meaningful variable declaration and use, and 2) the addition of comments to better comment the code base.

Discussed that in the December 7, 2016 conference call with the modeler, the new approach to improving code density (finished by June 1, 2016 as specified in the Professional Team Report from 2014) resulted in better commented code in the model.

Reviewed list of printed equations for variation of windspeed with height and their correspondence with code and variables as required by Standard CI-4.F.

Reviewed corrections to the coding errors associated with the earlier model versions (versions 7.0.a and 8.0).

Reviewed code for calculating windspeed at any height in the model.

Reviewed scripts associated with database interfaces.

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

50. CI-5, pages 127-128: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5 (pages 31-37).

Verified: YES

Professional Team Comments:

Discussed surface roughness and ZIP Code centroid updates verification.

Reviewed tests and test locations for the hazard model changes.

Reviewed tests implemented as part of the corrective actions to prevent a recurrence of the errors discovered in HurLoss 7.0.a and corrected in versions 7.0.b. and 8.0.a.

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

51. CI-6.D, page 129: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

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

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

CI-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed that there were no security breaches related to the model under review or since the previously accepted model.

Discussed improvements to network security since the previously accepted model.