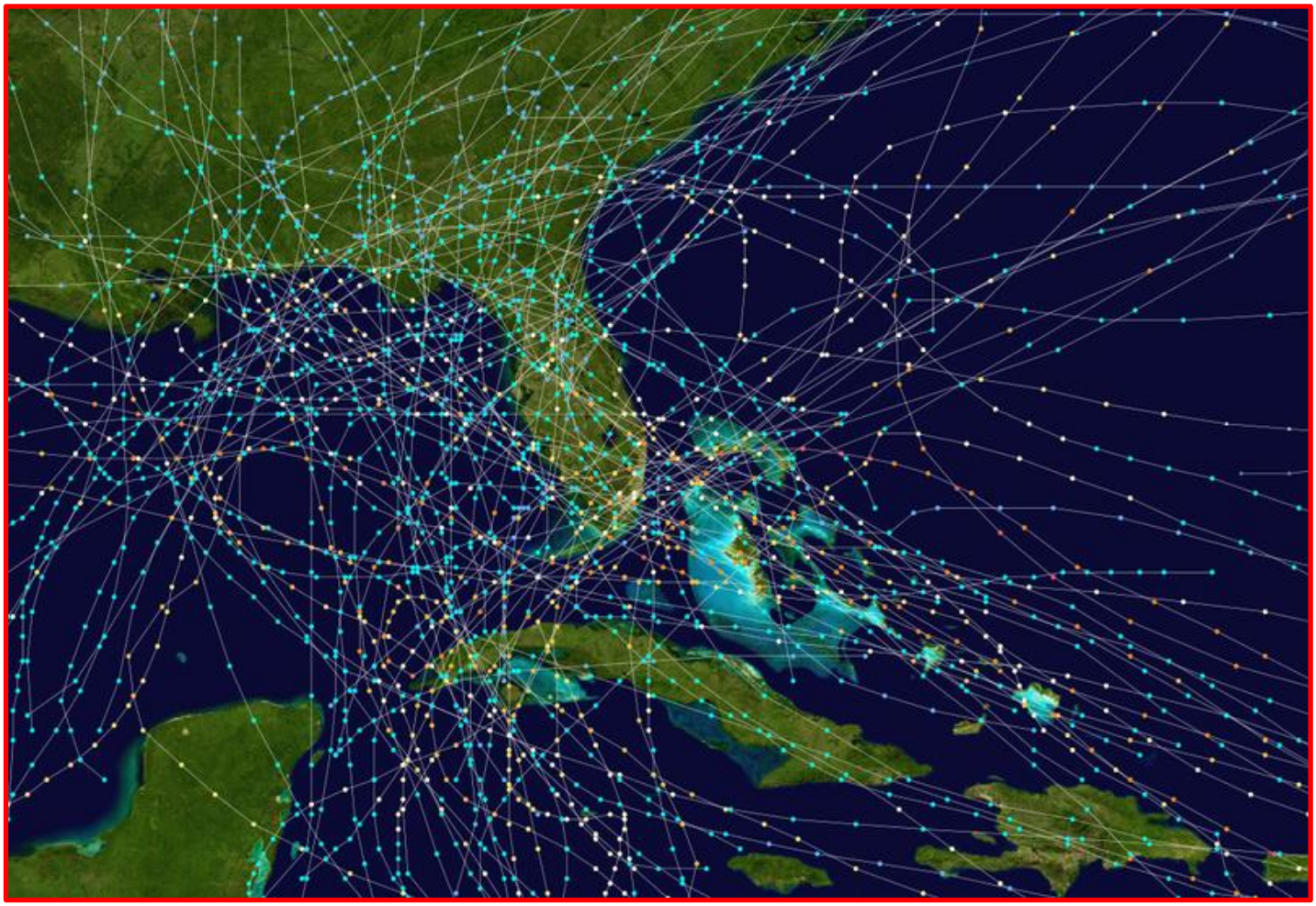
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2013 Standards



Applied Research Associates
On-Site Review: January 19-21, 2015

Additional Verification Review: April 13, 2015

On January 19-21, 2015, the Professional Team visited on-site at 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
Peter J. Vickery, Ph.D., P.E., Principal Engineer

Professional Team
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Tom Schroeder, Ph.D., Meteorologist
Marty Simons, ACAS, Actuary
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process. ARA informed the Professional Team of an error discovered January 17, 2015 in the source code implementation of the windfield necessitating a rerun of the output ranges and a majority of the meteorological and actuarial forms. ARA also stated that the 1935 storm updated in HURDAT2 was not updated in the historical storm set. As specified in the *Report of Activities*, if a problem necessitates the regeneration of the output ranges and the revised output ranges are not provided ten days prior to the on-site review, Standard A-6 (Loss Output) cannot be verified during the initial on-site review. Other standards also cannot be verified pending the review of Form A-4A and Form A-4B (Output Ranges).

The error in the windfield code which concerned the implementation of over-land versus over-water windspeeds also occurs in the current accepted HurLoss version 6.0.a model. The Professional Team reviewed with the modeler the process and requirements in the *Report of Activities* if there is a discovery of differences in a model after the model has been found acceptable by the Commission. ARA intends to notify the Commission of this discovery of Type III differences.

The review continued with ARA providing a detailed presentation of the following changes made in HurLoss Version 7.0:

- Methodology for back-allocating losses to coverages revised to reflect the differing impacts of demand surge on individual coverages.
- Ratio of contents loss to building loss and ratio of time element loss to building loss revised to allow contents and time element losses to vary with the building loss level when integrating over the range of possible building loss levels in computing expected losses.
- Land use/land cover database updated to the 2011 National Land Cover Database.
- Hurricane storm set updated to include storm data from the 2012 and 2013 hurricane seasons.
- Sea surface temperature, wind shear, and tropopause data sets updated to include data from the 2012 and 2013 hurricane seasons.
- An additional inflow angle changed from 0 radians to 0.15 radians for consistency with the value used in the hurricane windfield validation studies.

- Removed limits used to increase the boundary layer height in the sea-to-land transition and added a reduction factor on the transition speed of fast moving storms.
- ZIP Codes updated to use June 2014 data.

The Professional Team was unable to verify standards:

- G-1 pending verification of other standards
- G-2 pending signatory
- G-4 pending verification of other standards
- M-1 pending update of storm set and revised Form A-2
- M-3 pending verification of Standard M-1 and revised Form A-2
- M-4 pending verification of Standard A-6 and revised Forms M-2 and A-2
- M-6 pending verification of revised Form M-3
- S-1 pending verification of revised Forms S-2A, S-2B, S-4 and S-5
- S-5 pending verification of revised Form S-4
- S-6 pending verification of revised Form S-5
- V-1 pending verification of revised Forms S-4 and A-6
- V-2 pending verification of revised Figures 27 and 29
- V-3 pending verification of revised Form A-6
- A-2 pending verification of revised Form A-2
- A-6 pending verification of all revised Actuarial Forms and Forms S-2A, S-2B, and S-5
- C-4 pending verification of other standards and code documentation
- C-5 pending verification of other standards

At the exit briefing, modeler options as given in the *Report of Activities* were presented to the modeler.

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. Method for completion of Form A-6
2. Method for completion of Form V-3
3. Method for excluding storm surge losses from the modeled losses
4. Revisions to the expected insured loss computations for back-allocation of losses to coverages
5. Change in the model to allow the ratio of contents loss to building loss and the ratio of time element loss to building loss to vary with building loss level when integrating over the range of possible building loss levels to compute expected losses
6. Justification for the Florida Building Code vintage in the model
7. Justification for the 0% impact in Form V-2 for using high strength entry doors, garage doors, and sliding doors when these mitigation features are modeled individually.

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

- Page 25, G-1 Disclosure 5 – text revised for model changes (4) and (5) to include additional model updates
- Page 75, S-1 Disclosure 4 – revised for clarification
- Page 94, V-1 Disclosure 6 – text moved to Disclosure 11
- Page 95, V-1 Disclosure 13 – revised for clarification

- Page 101, V-2 Disclosure 8 – revised for clarification
- Page 101, V-2 Disclosure 10 – revised for clarification
- Page 133, G-1 Disclosure 4 – Brown et al. added to references
- Page 160, Form M-2.C – text updated to correspond to maximum windspeeds plotted on Figures 34-36

Additional Verification Review – April 13, 2015

ARA submitted revisions to the original November 2014 model submission (HurLoss 7.0) under the 2013 Standards on February 28, 2015. The Professional Team completed an additional verification review of HurLoss 7.0.a on April 13, 2015 in Raleigh.

The following individuals participated in the additional verification review.

ARA
Francis M. Lavelle, Ph.D., P.E., Vice President
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
Marty Simons, ACAS, Actuary
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Donna Sirmons, Staff

The additional verification review began with a discussion of the changes made after the January 2015 initial on-site review:

- Corrected error in probabilistic windfield model
- Standard G-1, Disclosure 5, Figures 6-8
- Standard S-1, Disclosure 6, Figures 19-20
- Forms M-1, M-2, S-2A, S-2B, S-5, V-3, A-1, A-4A, A-4B, A-5, A-6, A-7, and A-8
- Updated validation results in Standard S-5, Figure 23 and Form S-4
- Updated contents and ALE versus building damage plots, Standard V-2, Figures 27 and 29
- Updated LaborDay03 (1935) storm, Forms S-5 and A-2

ARA confirmed no additional changes were discovered or made since the February 28, 2015 revised submission.

The Professional Team reviewed all forms and materials in the re-submission that were impacted by the corrections in the probabilistic windfield model and updates noted above.

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 June 2 & 3, 2015 meetings for reviewing models for acceptability.

- G-1, Disclosure 5 – text revised for clarification on model change (4) under A., figure reference corrected to Figure 7 under B. (2), and revised Figure 6 caption for clarification
- A-1, Disclosure 4 – Figure 30 updated

- Forms G-2, G-3, G-5, and G-6 updated after review of model changes in HurLoss 7.0.a
- Form M-1 updated to correct for hurricane additions, deletions, and modifications.

All standards are now verified by the Professional Team.

Report on Deficiencies

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

1. Standard G-1, Disclosure 5.B (pages 26-28)
   Maps in Figures 4-8 are non-responsive to the Acceptability Process II.A.5.e.2 requirements (page 47) in the *Report of Activities*.

2. Standard G-3, Disclosure 3 (page 42)
   Response is non-responsive as the data, method and process used to convert from latitude and longitude to arrive at a ZIP Code has not been described.

3. Standard M-4, Disclosure 9 (page 61)
   Response is non-responsive as the exhibit for Hurricane Jeanne (Figure 14 in response to Standard M-5, Disclosure 2, page 65) is referenced here as supporting evidence for this disclosure. Figure 14 is unchanged from the previous submission so does not incorporate the latest roughness information used in the model.

4. Standard M-5, Disclosure 2 (page 66)
   Response is non-responsive as the use of unchanged Figure 15 from the previous submission is inconsistent with the response to Standard M-4, Disclosure 11 (page 61).

5. Form M-1.A (pages 149-150)
   Response is non-responsive as historical frequencies used in the table are unchanged from the 2013 *Report of Activities* and represent statistics from the August 2013 release date of HURDAT2. Instructions specify that Form M-1 should be updated to be consistent with the release date of HURDAT2 used by the modeling organization.

6. Form M-1.E (page 149)
   Response is non-responsive as multiple storms should have been adjusted to be consistent with the release date of HURDAT2 used by the modeling organization.

7. Form M-2 (pages 153-157)
   Response is non-responsive as the legends and map colors do not follow the Acceptability Process II.A.5.e.2 requirements (page 47) in the *Report of Activities*.

8. Standard V-1, Disclosure 18 (page 91)
   Response is unclear as Figure 25 on page 87 does not address rainfall rate and rain water infiltration.

9. Form A-2 (pages 183-185)
   Response is non-responsive as the list of hurricanes used in the table is unchanged from the 2013 *Report of Activities* and represent the minimum number of hurricanes from the August 2013 release date of HURDAT2. Instructions specify that Form A-2 should be updated to be consistent with the release date of HURDAT2 used by the modeling organization.

10. Form S-1 (page 161)
    Response is non-responsive as historical probabilities and frequencies used in the table are unchanged from the 2013 *Report of Activities* and represent statistics from the August 2013 release date of HURDAT2. Instructions specify that Form S-1 should be updated to be consistent with the release date of HURDAT2 used by the modeling organization.

11. Form S-3 (page 164)
    Response is incomplete as footnotes (1) and (2) in the column Stochastic Hurricane Parameter (Function or Variable) are not defined.

Report on Issues

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

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

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

Professional Team Pre-Visit Letter

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

Pre-Visit Letter

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

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

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

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

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

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

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

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

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

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

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

The pre-visit comments are grouped by standards sections.

GENERAL STANDARDS – Mark Johnson, Leader

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

*(*Significant Revision)*

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

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

Audit

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

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

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

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

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

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

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

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

C. For any modifications to Form A-4A (Output Ranges, 2007 FHCF Exposure Data) since the initial submission, additional versions of Form A-5 (Percentage Change in Output Ranges, 2007 FHCF Exposure Data):
   1. With the initial submission as the baseline for computing the percentage changes, and
   2. With any intermediate revisions as the baseline for computing the percentage changes.

D. Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide loss costs based on the 2007 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named *"hlpm2007c.exe"* for each model component change:
   1. Between the previously accepted submission and the revised submission,
   2. Between the initial submission and the revised submission, and
   3. Between any intermediate revisions and the revised submission.

Pre-Visit Letter

1. G-1, Disclosure 2, pages 19-23: Discuss the updates in the shear and SST databases and their impact on simulated hurricane intensity.

2. G-1, Disclosure 5.B, page 27: Explain the loss cost percentage change for Hardee County in Figure 5.

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

Professional Team Comments:

This standard cannot be verified pending verification of other standards.

Reviewed in detail the model changes provided in disclosure 5 plus additional changes to be noted in the submission document.

Reviewed graphical comparison of the 2013 submission to the 2011 submission by category for four Florida regions (northwest, northeast, southwest, and southeast) for the change in landfall rates (by pressure and by windspeed) due to additional starting points included and updating the sea surface temperature, wind shear and tropopause data in the hurricane hazard model.

Discussed the percentage change in loss costs for Hardee County attributed to decrease in roughness lengths for four ZIP Codes.

*****Additional Verification Review Comments*****

Reviewed percentage changes in average annual zero deductible statewide loss costs after correction in the source code for windfield calculations, updating of the LaborDay03 (1935) storm in the historical storm set, and all model changes combined.

Verified after resolution of outstanding issues with other standards.

G-2 Qualifications of Modeling Organization Personnel and Consultants

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

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

Audit

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

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

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

Pre-Visit Letter

3. G-2, Disclosure 2.B, page 37: Provide resumes of the new personnel.

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

Professional Team Comments:

This standard cannot be verified pending review of the model under the Statistical Standards by Marshall Hardy, ARA Statistician.

Reviewed resumes of new personnel:

- Fanquian Liu, Ph.D., Civil Engineering, Clemson University, Clemson, SC; M.S., Civil Engineering, Clemson University; B.S. Civil Engineering, Beijing University of Civil Engineering and Architecture, Beijing, China

- Laura Maxwell, FCAS, MAAA, B.S. Mathematics, Moravian College, Bethlehem, PA (consultant with Pinnacle Actuarial Resources)
- David Mizzen, B.E.Sc., Civil & Structural Engineering, University of Western Ontario, London, Ontario, Canada; M.S.C.E., Civil Engineering, Purdue University, West Lafayette, IN
- Lauren Mudd, Ph.D., Civil Engineering, Rensselaer Polytechnic Institute, Troy, NY; M.S., Civil and Environmental Engineering, University of Louisville, Louisville, KY; B.S., Civil and Environmental Engineering, University of Louisville

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

Discussed changes from the previous submission in Figure 10 (page 41), Model Workflow.

Discussed reason for change in actuarial consulting firm.

Discussed with Laura Maxwell her review of HurLoss 7.0 under the Actuarial Standards. Reviewed Laura's letter to ARA regarding her review in accordance with Actuarial Standards of Practice (ASOP) 38.

*****Additional Verification Review Comments*****

Verified after confirming review of the model under the Statistical Standards by Marshall Hardy, ARA Statistician and Form G-3 signatory.

G-3 Risk Location*

*(*Significant Revision)*

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

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

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

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

E. Geocoding methodology shall be consistent and justifiable.

Audit

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

Pre-Visit Letter

4. G-3.C, page 41: Provide maps of previous and current ZIP Code centroid locations (as has been done in previous reviews).
5. G-3, Disclosure 3, page 42: Explain the methodology and process for conversion from latitude and longitude to street address or ZIP Code.

Verified: YES

Professional Team Comments:

Reviewed new ZIP Code boundaries updated to use June 2014 data.

Discussed the methodology used to compute ZIP Code surface roughness and ZIP Code level windspeeds.

Reviewed scatter plot of ZIP Code centroid changes. Reviewed map of the +1.7% change in average annual loss due to the changes in the ZIP Code centroid determinations.

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

Reviewed in detail ZIP Code centroid movements in Bay and Franklin counties.

Discussed adjustments for ZIP Code centroids located over water. Reviewed ZIP Code 32320 in Franklin County.

Reviewed the methodology and process for converting from latitude and longitude to street address or ZIP Code. Discussed handling several different scenarios in the geocoding process.

Reviewed new coastline and distance to coast calculations included with the ZIP Code update. This additional change will be added to the list of model changes in G-1 (Scope of the Computer Model and Its Implementation), Disclosure 5.

Reviewed geographic display of the new modeled coastline for Bay County compared to the previous modeled coastline.

G-4 Independence of Model Components

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

Audit

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

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

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

Professional Team Comments:

This standard cannot be verified pending verification of other standards.

*****Additional Verification Review Comments*****

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

Verified after resolution of outstanding issues with other standards.

G-5 Editorial Compliance

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

Audit

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

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

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

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

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

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

7. Form G-7 (Editorial Certification) will be reviewed.

Verified: YES

Professional Team Comments:

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

Discussed no changes have been made in the editorial review process since the previous submission.

Meteorological Standards – Tom Schroeder, Leader (January)
Jenni Evans, Leader (April)

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

6. Form M-1.E, page 149: Describe how changes in HURDAT2 due to the re-analyses and additions of new hurricane seasons are incorporated into the Base Hurricane Storm Set. Individual cases may be reviewed.

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

Professional Team Comments:

This standard cannot be verified pending update of the historical storm set and verification of revised Form A-2.

Reviewed the process for updating the historical storm set with updated storm tracks in HURDAT2. Reviewed comparisons of modeled versus historical observed windspeeds for NoName08 (1948) at several stations. Reviewed change in NoName08 (1948) storm track compared to the storm track for the hurricane in the previous submission.

Reviewed Brown et al., "A Fresh Look at Tropical Cyclone Pressure-Wind Relationships Using Recent Reconnaissance-Based 'Best Track' Data (1998-2005), reference and equations for calculating central pressure using Vmax. Reference is to be included in the revised submission.

Reviewed plots of the changes to NoName03 (1935) for track, central pressure, Rmax, and Holland B parameter. Reviewed comparison of the maximum gust wind speeds over-land for the 2011 storm track to the 2013 storm track.

*****Additional Verification Review Comments*****

Reviewed process for updating historical hurricanes.

Reviewed update to the historical storm set reflecting the HURDAT2 reanalysis of the LaborDay03 (1935) storm. Discussed the resulting reduction in modeled peak windspeed over-land.

Reviewed comparisons of modeled versus historical observed central pressure and Vmax for the LaborDay03 (1935) storm. Discussed availability of historical data for validation.

Reviewed time series comparisons of Rmax and Holland B parameter for the LaborDay03 (1935) storm.

Discussed revisions to 2004 and 2005 hurricanes listed in Form M-1. Form M-1 was revised. Reviewed Form M-1.

M-2 Hurricane Parameters and Characteristics

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

Audit

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

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

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

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

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

6. Describe and justify the value(s) of the far-field pressure used in the model.

Verified: YES

Professional Team Comments:

Discussed the reasons for the default far-field pressure value of 1013 used for stochastic storms while the modeling of historical storms use various values based on available data.

Discussed the modification of fast moving storm factors and the effect on windspeeds in Florida. This additional change in the hurricane hazard model is to be added to the list of model changes in G-1 (Scope of the Computer Model and Its Implementation), Disclosure 5 in the revised submission.

Discussed the change permitting use of alternative time steps in model runs. Specifically discussed potential impacts upon windspeed.

Discussed the change in reference points for distance from site test to be based on the centroid of points rather than a fixed point.

Reviewed the removal of limits used to increase the boundary layer height in the sea-to-land transition and the effect on windspeeds. This additional change in the hurricane hazard model is to be added to the list of model changes in G-1 (Scope of the Computer Model and Its Implementation), Disclosure 5 in the revised submission.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

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

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

Saffir-Simpson Hurricane Scale:

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

Audit

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

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

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

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

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

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

Professional Team Comments:

This standard cannot be verified pending verification of Standard M-1 and revised Form A-2.

*****Additional Verification Review Comments*****

Verified after resolution of outstanding issues with Standard M-1 and revised Form A-2.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

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

B. The land use and land cover database shall be consistent with National Land Cover Database (NLCD) 2006 or later. Use of alternate data sets shall be justified.

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

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

Audit

1. Provide any modeling organization-specific research performed to develop the windfield functions used in the model. Identify the databases used.

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

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

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

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

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

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

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

Pre-Visit Letter

7. M-4, Disclosure 8, page 61: Demonstrate how the new LULC database has been incorporated into the model. Individual cases may be reviewed.

8. M-4, Disclosure 10, page 61: The method for updating the historical windfield footprints will be examined. Updates to Hurricane NoName09 from 1945 (AL091945) will be compared with the same hurricane as presented in the previous submission.

9. Form M-2, pages 153-157: Discuss the relative variation of windspeed minima versus maxima between the three temporal sampling periods.

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

Professional Team Comments:

This standard cannot be verified pending verification of Standard A-6 and revised Forms M-2 and A-2.

Reviewed the methodology used to calculate surface roughness and the process used to update the tree canopy data from National Land Cover Data 2001 to National Land Cover Data 2011, to update the Land Use Land Cover data from National Land Cover Data 2006 to National Land Cover Data 2011, and to update the ZIP Code boundaries from 2012 to 2014.

Reviewed scatter plot comparison of the Florida ZIP Code terrain roughness in the previous submission to the current submission.

Reviewed contour map of Florida tree canopy data. Discussed adjustments to the percentage tree canopy for developed open terrain and developed low intensity residential.

Reviewed map of percentage change in 2007 FHCF zero deductible average annual losses due to the 2011 National Land Cover Data update.

Reviewed changes to NoName09 (1945) hurricane track and comparison of modeled versus historical observed windspeeds and revised track compared to that in previous submission.

Reviewed changes in Form M-2 figures compared to the previous submission. Form M-2 will be revised after corrections to the windfield computer code.

Discussed the reason for changing the inflow angle from zero radians to 0.15 radians. Discussed the reasons for not putting the inflow angle 0.15 radian value into the stochastic model when it is used in the historical storms data.

Reviewed maps of percentage changes in 100-year return period winds and 2007 FHCF Annual Average Loss.

Reviewed computer code with change in inflow angle set to 0.15 radians.

Reviewed summary comparison plots of modeled versus observed windspeeds with the inflow angle set at 0.0, 0.15, and 0.30 radians for Hurricane Jeanne (2004). Discussed the effect of the change in the inflow angle upon the maximum winds.

Reviewed map of the percentage difference of 250-year return period windspeeds.

*****Additional Verification Review Comments*****

Discussed that change to treatment of inflow angle only applied to stochastic storms.

Verified after resolution of outstanding issues with Standard A-6 and revised Forms M-2 and A-2.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

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

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

Audit

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

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

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

Verified: YES

Professional Team Comments:

Reviewed the source code error and its correction for implementing the windfield model for use of over-land versus over-water windspeeds.

*****Additional Verification Review Comments*****

Discussed in detail method for transition of winds from over-water to over-land and treatment of boundary layer depth. Reviewed relevant equations and their implementation in the model code.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

1. Form M-3 (Radius of Maximum Winds and Radii of Standard Wind Thresholds) and the modeling organization's sensitivity analyses provide the information used in auditing this standard.

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

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

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

Professional Team Comments:

This standard cannot be verified pending verification of revised Form M-3.

*****Additional Verification Review Comments*****

Verified after review of revised forms.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

1. Forms S-1 (Probability and Frequency of Florida Landfalling Hurricanes per Year), S-2A (Examples of Loss Exceedance Estimates, 2007 FHCF Exposure Data), S-2B (Examples of Loss Exceedance Estimates, 2012 FHCF Exposure Data), and S-3 (Distributions of Stochastic Hurricane Parameters) will be reviewed. Provide justification for the distributions selected including, for example, citations to published literature or analyses of specific historical data.

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

Pre-Visit Letter

10. Form S-2.A, page 162: Explain the large change in values for Form S-2A compared to the previous submission (both Part A and Part B).

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

Professional Team Comments:

This standard cannot be verified pending verification of revised Forms S-2A, S-2B, S-4, and S-5.

Reviewed a comparison of the results for Form S-2A to the previous submission. Discussed consistency in the mean loss reduction with the zero deductible statewide loss reduction under Standard G-1 related to the current model changes.

*****Additional Verification Review Comments*****

Verified after review of revised Forms S-2A, S-2B, S-4, and S-5.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no changes in model methodology from the previous submission and no new sensitivity tests were required.

Reviewed sensitivity tests on adjusting the time step setting, the inflow angle, and domain size.

S-3 Uncertainty Analysis for Model Output

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified no changes in model methodology from the previous submission and no new uncertainty tests were required or performed.

S-4 County Level Aggregation

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

Audit

1. Provide a graph assessing the accuracy associated with a low impact area such as Nassau County. We would expect that if the contribution error in an area such as Nassau County is small, the error in the other areas would be small as well. Assess where appropriate, the contribution of simulation uncertainty via confidence intervals.

Verified: YES

Professional Team Comments:

Discussed use of 300,000 simulated years and the basis for this number remaining adequate.

S-5 Replication of Known Hurricane Losses

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

Audit

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

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

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

4. Form S-4 (Validation Comparisons) will be reviewed.

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

Pre-Visit Letter

11. Form S-4, pages 167-168: Explain why the modeled losses for Comparison Number 3 have not changed.

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

Professional Team Comments:

This standard cannot be verified pending verification of revised Form S-4.

Discussed results in Form S-4, the timing of generating comparisons with model updates and changes, and other forms better suited to assess model changes.

*****Additional Verification Review Comments*****

Verified after review of revised Form S-4 and Figure 23.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

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

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

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

Professional Team Comments:

This standard cannot be verified pending verification of revised Form S-5.

*****Additional Verification Review Comments*****

Verified after review of revised Form S-5.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

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

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

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

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

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

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

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

Audit

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

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

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

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

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

5. Justify the construction types and characteristics used.

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

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

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

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

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

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

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

Pre-Visit Letter

12. V-1, Disclosure 7, page 89: Describe the four regions in Florida used for the building vulnerability functions.

13. V-1, Disclosure 8, page 89: Explain how building code adoption and enforcement are considered in the model.

14. Form V-1, pages 173-176: Compare the results in Form V-1 with the previous submission.

Verified: ~~NO~~ YES

Professional Team Comments:

This standard cannot be verified pending verification of revised Forms S-4 and A-6.

Reviewed building loss models and verified no changes from the previously accepted model.

Reviewed the methodology and implementation of back-allocation of losses to coverages. Verified no changes in building vulnerability functions from the previously accepted model.

Reviewed the four building vulnerability regions in Florida and the basis for determining the region boundaries. Discussed the HUD zones used for mobile home vulnerability functions.

Discussed how building code adoption is considered in the model based on the year of construction and that the effect of building code enforcement is not a separate factor in the development of the vulnerability functions. Discussed the building code band years.

Reviewed ARA's approach to primary and secondary factors and the number of base vulnerability function combinations. Discussed the interaction of the mitigation factors.

Discussed the justification for including building codes up to 2001 Florida Building Code vintage in the model. The Professional Team recommends that the modeler present this justification to the Commission during the Trade Secret session.

Reviewed the 2008 Florida Residential Wind Loss Mitigation Study and the 2006 Florida Building Code loss relativities.

The Professional Team recommends implementation of a more recent vintage Florida Building Code in the model.

Reviewed Form V-1 results compared with the previous submission noting differences in Part A are due to the current model change in terrain roughness and the differences in Part B are principally due to the revised exposure for completing Form V-1.

Reviewed methodology and flowchart for modeling exterior attached and detached structure losses.

Reviewed statistics from an exterior structures survey of site built homes and mobile homes for percentage of attached, detached, and both attached and detached exterior structures.

Discussed newly obtained Hurricane Katrina (2005) loss data.

Discussed the need to review the newer vintage of underlying data used to develop loss functions and if necessary, revise the loss function in the future model update.

Discussed the source and data used for developing vulnerability functions for unknown and partially unknown construction type and/or primary characteristics.

Discussed the response to Disclosure 13 and how the location of apartment unit or condo unit might be addressed. The response to Disclosure 13 is to be modified in the revised submission.

Reviewed building vulnerability function consistency with insurance data. Form S-4 to be revised.

*****Additional Verification Review Comments*****

Verified after review of revised Forms S-4 and A-6.

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

*(*Significant Revision)*

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

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

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

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

15. V-2, Disclosure 8, page 96: Explain the response to this disclosure in comparison to the response to V-2, part E.

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

Professional Team Comments:

This standard cannot be verified pending verification of revised Figures 27 and 29.

Reviewed contents and time element losses integrated as a variable function of building loss level. Discussed change to vary loss ratios with building loss level when integrating over the range of possible building loss levels to compute expected losses. Reviewed the source code.

Reviewed Figures 27 and 29 with scales given on the *x*- and *y*- axes. Figures to be revised using the updated model.

Reviewed vulnerability matrix and curves for loss varying across the different coverages.

Discussed the modeled time element loss due to damage to infrastructure is imbedded in the claims data to the extent data are available rather than attempting to explicitly model the impacts of storm surge and flood damage to local and regional infrastructure. Response to disclosure 8 to be modified for clarification in the revised submission.

Discussed response to Disclosure 10 for clarification and consistency with revised response to Disclosure 8. Response to Disclosure 10 to be modified in the revised submission.

Reviewed flowchart for development of time element vulnerability functions and discussed its consistency with the response to Disclosure 13.

*****Additional Verification Review Comments*****

Verified after review of revised Figures 27 and 29.

V-3 Mitigation Measures*

*(*Significant Revision)*

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

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

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

Audit

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

2. Form V-2 (Mitigation Measures – Range of Changes in Damage) and Form V-3 (Mitigation Measures – Mean Damage Ratios and Loss Costs, Trade Secret item) provide the information used in auditing this standard.

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

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

Pre-Visit Letter

16. Form V-2, pages 177-179: Compare the results in Form V-2 with the previous submission.

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

Professional Team Comments:

This standard cannot be verified pending verification of revised Form A-6.

Discussed the 0% impact in Form V-2 for using high strength entry doors, garage doors, and sliding doors when these mitigation features are modeled individually. Discussed the modeling decisions and their justification made in this regard. The Professional Team recommends that the modeler present this justification to the Commission in the Trade Secret session.

Reviewed the results in Form V-2 with the previous submission. Discussed the changes relative to the previous submission due to mapping of ZIP Code 33921 and the change in roughness factor.

Reviewed Form V-3 and confirmed consistency with Form V-2.

*****Additional Verification Review Comments*****

Verified after review of revised Form V-3 and Form A-6.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeling Input Data

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

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

Audit

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

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

Verified: YES

Professional Team Comments:

Discussed with Laura Maxwell her review of the model input data and the follow-up process for questions and additional data with the modeler.

Verified that the model does not take into account flood or storm surge other than the effects of storm surge damage on the infrastructure.

A-2 Event Definition

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

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

Audit

1. The model will be reviewed to determine that the definition of an event in the model is consistent with this standard.
2. The model will be reviewed to determine that by-passing storms and their effects are considered in a manner that is consistent with this standard.
3. The model will be reviewed to determine whether (if so, how) the model takes into account flood or hurricane storm surge.

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

Professional Team Comments:

This standard cannot be verified pending verification of revised Form A-2.

Discussed with Laura Maxwell her understanding of the definition of an event in the model.

*****Additional Verification Review Comments*****

Verified after review of revised Form A-2.

A-3 Coverages*

*(*Significant Revision)*

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

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

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

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

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the revised methodology for back-allocating losses to coverages to reflect the differing impacts of demand surge on individual coverages.

A-4 Modeled Loss Cost and Probable Maximum Loss Considerations

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

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

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

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

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

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

Audit

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

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

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

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

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

Pre-Visit Letter

17. A-4.C, page 109: Describe the process used to ensure that storm surge losses are excluded from the model's loss cost outputs.

Verified: YES

Professional Team Comments:

Reviewed the change in back-allocating losses to coverages to reflect the differing impacts of demand surge on individual coverages. Discussed change also includes extensions to the financial model that have no impact on Florida loss costs for risks with limits by coverage and deductible types.

Reviewed the computer code for back-allocating losses to coverages.

The Professional Team recommends ARA present the revisions to the expected insured loss computations due to the back-allocation of losses to coverages during the Trade Secret session.

Reviewed process for applying demand surge to ground-up losses by coverage. Verified no demand surge is applied to contents losses.

Reviewed process for applying deductibles, limits and coinsurance.

Verified storm surge losses are not included in the vulnerability functions or modeled loss costs.

A-5 Policy Conditions

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

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

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

Audit

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

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

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

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

Verified: YES

Professional Team Comments:

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

Discussed the process for applying deductibles when there are multiple events in a year. Reviewed the deductible source code.

Reviewed the relationship of various deductibles.

A-6 Loss Output*

*(*Significant Revision)*

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

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

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

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

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

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

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

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

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

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

1. masonry construction versus frame construction,

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

3. inland counties versus coastal counties, and

4. northern counties versus southern counties.

A-6 Loss Output (Continued)

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

Audit

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

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

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

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

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

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

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

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

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

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

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

Pre-Visit Letter

18. Form A-4B, page 239: For 0% deductibles, frame and masonry average loss costs by county have a fairly consistent ratio ranging from 0.9 to 1.12 while the statewide ratio is only 0.57. The masonry loss costs for average is given as 4.796 which seems high relative to the county level values. Explain this potential anomaly.

19. Form A-4B, page 239: Describe how the file hlpm2012c.txt was processed for use in completing Form A-4B.

20. Form A-5.A, page 250: Explain the percentage change in loss costs for inland frame and masonry renters and inland frame and masonry condo unit.

21. Form A-5.C, page 252: Explain the percentage decrease for frame renters loss costs in Dixie County in Figure 59.

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

Professional Team Comments:

This standard cannot be verified pending verification of all revised Actuarial Forms and revised Forms S-2A, S-2B, and S-5.

Discussed with Laura Maxwell her review and understanding of Form A-2, Form A-4A, Form A-4B, Form A-5, and Form A-6.

Reviewed email correspondence between Laura Maxwell and the modeler with questions and answers and additional data provided for her review of the model under the Actuarial Standards.

Reviewed the spreadsheet for processing the hlpm2012c.txt file for completing Form A-4B. Reviewed remapping lookup tables for mobile homes and unknown construction. Reviewed pivot table for verifying totals to ensure no risks have been missed.

Reviewed the percentage change in Form A-5 in loss costs for inland frame and masonry renters and inland frame and masonry condo unit driven by the model change to allow the ratio of contents loss to building loss and the ratio of time element loss to building loss to vary with building loss level.

Reviewed the percentage decrease in Form A-5 for frame renters loss costs in Dixie County driven by the changes in the hurricane hazard model rather than the vulnerability model. The percentage decrease for Dixie County is also seen in Figure 5 (page 28) for the land use land cover model update, in Figure 6 (page 29) for the event set model update, and in Figure 8 for all the model changes combined.

Reviewed comparison of Form A-1 and Form A-3 loss costs for several ZIP Codes in Collier County, Manatee County, Orange County, Pinellas County, Sarasota County, Sumter County, and Miami-Dade County. Discussed percentage change in loss costs driven by the new coastline depiction and the terrain roughness update. Reviewed map of Collier County ZIP Codes 34138 and 34139.

Discussed the change in Form A-2 loss costs in the January 7, 2015 revised submission from the original November 2014 submission for NoName13 (1944) storm. Reviewed plot of the change in the maximum winds.

*****Additional Verification Review Comments*****

Verified after review of all revised Actuarial forms and Forms S-2A, S-2B, and S-5.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

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

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

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

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

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

Audit

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

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

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

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

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

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

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

Pre-Visit Letter

22. C-1.B, page 119: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

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

Reviewed documentation associated with changes to the model (HurLoss version 7.0) compared with the currently accepted version.

Reviewed the table as required in Standard C-1, Audit Item 6.

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

Reviewed the correspondence among the following for calculating the mathematical relationship between Vmax and central pressure: (1) slides, (2) journal paper “A Fresh Look at Tropical Cyclone Pressure-Wind Relationships using Recent Reconnaissance-Based “Best Track” data (1998-2005)” by D. P. Brown, J. L. Franklin, and C. Landsea (NOAA/NWS/NCEP/Tropical Prediction Center, Miami, Florida, (3) a MATLAB source file, and (4) a spreadsheet formula. Discussed the differences among several versions of the equations presented in the Brown et al. paper and reviewed the process workflow explanation provided by the modeler as to how these versions related to one another.

*****Additional Verification Review Comments*****

Reviewed the revised table required in Standard C-1, Audit Item 6.

C-2 Requirements

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

Audit

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

Pre-Visit Letter

23. C-2, page 120: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed the updated requirements for changes made to the model, resulting in HurLoss Version 7.0. These requirements included the five changes specified in the modeler's submission as well as the coastline update.

C-3 Model Architecture and Component Design*

*(*Significant Revision)*

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

Audit

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

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

Verified: YES

Professional Team Comments:

Reviewed the flowchart for calculating terrain roughness by ZIP Code. Verified this was unchanged since the currently accepted submission from the modeler.

Reviewed the Expected Loss Computations Overview.

Reviewed the HurLoss ZIP Code mapping algorithm design.

Reviewed a flowchart for calculating losses associated with attached, detached (i.e., appurtenant), and combined structures.

Reviewed a document describing the inflow and adjustment term for Lifesim_Wind.

C-4 Implementation

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

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

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

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

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

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

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

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

Audit

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

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

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

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

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

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

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

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

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

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

Professional Team Comments:

This standard cannot be verified due to (1) incomplete commenting of code associated with the windfield calculations, and (2) pending verification of other standards.

Discussed with the modeler the method used to assert exception conditions within the source code.

Reviewed code for the relation between maximum wind velocity and central pressure.

Reviewed C-4.D for comment density in various locations within the modeler's source code.

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 for 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.

Reviewed additional comments placed in the windfield module, which are incomplete and will be addressed prior to the follow-up visit.

Reviewed the mapping between equation-based and code-based variables for the expected loss computation.

Reviewed the code implementation for expected loss computation.

Reviewed the inclusion of a non-zero inflow angle to the model version under review.

Reviewed the implementation of the calculation of deductibles associated with multiple perils within the same year.

Reviewed the implementation of the process of mapping data provided in hlpm2012c.txt to the modeler's internal format needed to complete Form A-4B.

Discussed with the modeler that some parts of the code were written at a time when FORTRAN had more constraints on variable name length, and that some variables may have not been updated to reflect later versions of FORTRAN where these constraints are less stringent.

Reviewed the spreadsheet formula for cross-verification against the two formulas specified in Brown et al.

Reviewed code for back-allocating losses to coverages.

Reviewed code for computing contents and time element losses.

Reviewed code containing the windfield error and its correction.

*****Additional Verification Review Comments*****

Reviewed code documentation associated with error correction in the probabilistic windfield calculation.

Reviewed in detail implementation of the methodology used for calculating over-water and over-land boundary layer depth.

Discussed that there were insufficient comments in the code calculating boundary level height and continuity.

Verified after modeler inserted additional comments and after resolution of outstanding issues with other standards.

C-5 Verification*

*(*Significant Revision)*

A. General

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

B. Component Testing

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

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

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

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

C. Data Testing

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

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

Audit

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

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

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

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

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

6. The response to Disclosure 1 will be reviewed.

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

Pre-Visit Letter

24. C-5, pages 124-125: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5.

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

Professional Team Comments:

This standard cannot be verified pending verification of other standards.

Discussed a visual inspection procedure used by the modeler for verifying the external Land Use Land Cover (LULC) and canopy data. This procedure included a comparison between prior and current data versions.

Reviewed a verification of the effects of a non-zero storm inflow angle to peak gust windspeed and wind direction.

Reviewed scripts, modules, and tools used for verification and quality assurance relating to ZIP Code centroids and terrain roughness.

*****Additional Verification Review Comments*****

Reviewed the comparison based cross-check verification.

Reviewed point-based comparisons as an additional model update verification test. Discussed that this comparison was used for the current model implementation.

Verified after resolution of outstanding issues with other standards.

C-6 Model Maintenance and Revision*

*(*Significant Revision)*

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

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

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

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

Audit

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

2. The policy for model revision will be reviewed.

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

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

Pre-Visit Letter

25. C-6.D, page 126: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed the model version history over the past 5 years, leading up to the current model, HurLoss Version 7.0.

*****Additional Verification Review Comments*****

Reviewed the updated model, HurLoss Version 7.0.a, dated February 28, 2015.

Discussed the need for the modeler to design and implement a process (1) for mitigating future errors, and (2) for improving the quality of legacy code.

Reviewed the modeler written plan to instrument a refactoring of legacy code which will include enhanced comment density.

C-7 Security

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

Audit

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

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

Verified: YES

Professional Team Comments:

Verified that there were no security events or breaches related to the model under review.