Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2007 Standards

Applied Research Associates, Inc.

On-Site Review
May 6-8, 2008

On May 6-8, 2008 the Professional Team visited on-site at Applied Research Associates, Inc. (ARA) in Raleigh, North Carolina. The following individuals participated in the review.

ARA

Douglas Collins, Actuarial Consultant (via phone)
Chris Driscoll, Senior Computer Scientist
Brian Grant, Computer Scientist
Francis M. Lavelle, Ph.D., P.E., Principal Engineer
Janet MacKenzie, Senior Technical Editor
Jeffrey C. Sciaudone, P.E., Senior Scientist
Peter J. Vickery, Ph.D., P.E., Principal Engineer
Dhiraj Wadhera, Staff Scientist

Professional Team

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

The review began with introductions and an overview of the audit process. ARA presented the changes made in the 2008 model (HurLoss 4.1):
- Updated to include data from the 2006 hurricane season
- Updated the ZIP Codes in the model to July 2007
- Updated the surface roughness model based on land use and land cover data from satellite images collected between July 1999 and June 2003.

The Professional Team reviewed the following corrections to be included in the revised submission provided to the Commission prior to the May 20-22, 2008 meetings.
1. Page 21, G-1.4, References section updated with additional references added in Disclosures listed below
2. Page 22, G-1.6, updated response for substantive changes in the submission
3. Page 49, M-1.A., date for storm database corrected
4. Page 50, M-2, remove incorrect values of mean and standard deviation for the negative binomial distribution
5. Page 51, M-2, correct time period for Holland B
6. Page 52, M-2.1, correct time period for Holland B
7. Page 52, M-2.2, provide reference to Vickery and Skerlj 2005 gust factor paper
8. Page 52, M-2.3, clarification that error terms in equations (1) and (2) have a bi-normal distribution
9. Page 53, M-2.5, provide reference to Vickery et al. 2008
10. Page 53, M-2.8, correct date for historical data used in development of the storm track model
11. Page 55, M-3.2, clarification provided on flight level data used in developing Rmax
12. Page 56, M-4.1, caption for Figure 7 clarified

13. Page 57, M-4.4, additional information provided on how 3-second gust windspeed is computed using the ESDU gust factor model
14. Page 59, M-5.A, remove reference to Florida Water Management District land use land cover dataset
15. Page 69, Form M-2, Figure 69 revised to use correct color coding
16. Page 71, Form M-3, revised for correct order of values in table and box plot added as required in C
17. Page 85, A-1.1, wording revised to accurately describe how damage is included in the calculation of loss costs
18. Page 98, A-7.2, last sentence in disclosure removed (not applicable)
19. Page 100, A-9.B, clarification provided on building unlivability being dependent upon time
20. Page 120, Form A-4, Figure 24 revised to use correct color coding
21. Page 122, Form A-5, correct lettering of responses
22. Page 208, S-1.1, clarification provided on distributions of translation speed, heading, and distance of closest approach
23. Page 220, S-6.1, correction of caption and *y*-axis label for Figure 42

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the March 12, 2008 meeting. The deficiencies were corrected by the established time frame and the corrections have been verified. ARA provided updated Expert Certification Forms G-1 and G-2 which were not originally included in their responses to the deficiencies.

1. Standard G-1, Disclosure 2 (pages 17-21)
   The disclosure calls for a "comprehensive" not "concise" summary of the model. A reader should be able to recreate the structure of the model from this summary without reference to later Standards. This is not possible with the present version as multiple references are given for the same model component. Further, information about many salient details of the model (e.g., vortex structure, decay over land) are not given.

2. Standard G-1, Disclosure 2 (page 19)
   Modeler references Vickery et al. (2008) that is unpublished.

3. Standard G-1, Disclosures 7, 8 & 9 and Standard G-5, Disclosure 1 (pages 45-48)
   Expert Certifications must be updated and reflect reviews on the current submission date for Forms G-4, G-5, G-6, G-7 and Appendices A and B.

4. Standard M-2, Disclosure 7 (page 53)
   Non-responsive due to multiple references for the same item.

5. Standard A-10, Disclosure 4 (page 103)
   Provide justification for changes.

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 Professional Team will interview the individuals signing the Expert Certification Forms G-1 through G-7.

Provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and if available, the 2005 hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Be prepared to provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2002 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2002 FHCF exposure data. Be prepared to discuss changes in loss costs from the use of the 2007 FHCF exposure data from the loss costs produced using the 2002 FHCF exposure data.

When the Professional Team arrives on-site, a copy of Form V-3 must be available. Also provide 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.

Provide for the Professional Team's review, all engineering data (post event surveys, tests, etc.) received since 2005 (three years prior). Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Provide for the Professional Team's review documentation binders, validation studies, and supporting information for the ZIP Code and terrain updates as indicated in ARA Checklist Item 3 on page 11.

GENERAL STANDARDS – Mark Johnson, Leader

G-1   Scope of the Computer Model and Its Implementation

The computer model shall project loss costs for personal lines residential property from hurricane events.

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 loss costs. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.

2. All software located within the model, used to compile data used by the model, used to validate the model, and used to project model loss costs (1) fall within the scope of the Computer Standards, and (2) will be reviewed interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each Standard).

3. Databases or data files relevant to the modeler's submission will be reviewed.

Pre-Visit Letter

1. G-1, Disclosure 2, page 19 – Discuss the material in Vickery et al. (2008). In particular, describe this update regarding the module in which it resides, the code development, and its verification by someone other than the developer.

2. G-1, Disclosure 3, page 21 – Provide the more detailed, proprietary flow-charts. Provide the more detailed, proprietary flow-charts.

3. G-1, Disclosure 5, page 22 – Discuss the relevance of the material in Vickery et al. (2008) in reference to the response provided.

4. G-1, Disclosure 5, page 22 – Describe the process that led to the discovery of the third party vendor's errors and how it was addressed by ARA.

Information presented to the Professional Team:
   - G-1, page 17 – The methodology used in the model to predict damage and loss, given a windspeed, has been presented to the Professional Team during previous visits.
   - G-1.3, page 21 – More detailed, proprietary flow-charts have been presented to the Professional Team. (PVL #2)

Verified: YES

Professional Team Comments:

Documentation reviewed:
- Vickery, P.J., Wadhera, D., Twisdale, L.A. Jr., Lavelle, F.M., 2008: United States Hurricane Wind Speed Risk and Uncertainty. ASCE Journal of Structural Engineering. (submitted)
- Vickery, P.J. and Wadhera, D., 2008: Statistical Models of Holland Pressure Profile Parameter and Radius to Maximum Winds of Hurricanes from Flight Level Pressure and H*Wind data. Journal of Applied Meteorology and Climatology. (in press)
- Vickery, P.J., Wadhera, D., Powell, M.D., and Chen, Y., 2008: A Hurricane Boundary-Layer and Wind Field Model for Use in Engineering Applications. Journal of Applied Meteorological and Climatology. (accepted for publication)
- Hurloss Risk Analysis Suite, Terrain Database, Volume III-B

Discussed the error identified in the third-party GIS (geographical information system) software package that resulted in incorrect tabulations of land use land cover data by ZIP Code. Reviewed the internal process which detected the bug. Reviewed the work around process used to account for the bug in the third-party software and the validation of the workaround results.

G-2   Qualifications of Modeler Personnel and Consultants

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

B. The model or any modifications to an accepted model shall be reviewed by either modeler 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 be signatories on Forms G-1 through G-6 as applicable and shall abide by the standards of professional conduct if adopted by their profession.

Audit

1. The professional vitae of modeler 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, G-2, G-3, G-4, G-5, G-6, 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 modeler personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

5. G-2, Disclosure 2.B, page 32 – Provide a curriculum vita or resume for Jeff Sciaudone and Janet MacKenzie.

Verified: YES

Professional Team Comments:

Reviewed resumes of personnel new to this year's model:
  - Janet MacKenzie, B.A. English, King College, Bristol, Tennessee
  - Jeff Sciaudone, M.S. Civil/Structural Engineering, Clemson University, B.S. Civil Engineering, Clemson University

Verified that no former employees left for violation of professional ethical standards.

G-3   Risk Location

A. ZIP Codes used in the model shall be updated at least every 24 months using information originating from the United States Postal Service. The United States Postal Service issue date of the updated information shall be reasonable.

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

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

Audit

1. Provide geographic displays for all ZIP Codes. The location of specific centroids will be reviewed.

2. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.

Pre-Visit Letter

6. G-3.C, page 35 – Provide maps showing the ZIP Code boundaries and associated centroids.

7. G-3, Disclosure 1, page 35 – ZIP Code implementation will be reviewed.

Trade Secret information to be presented to the Professional Team (page 11):
- The Professional Team will be shown documentation binders, validation studies and supporting information for the ZIP Code and terrain updates. Any other materials will be dependent upon requests or suggestions from the Professional Team.
- G-3.C, page 35 – Maps showing the zip code boundaries and the associated centroids will be available to the Professional Team. (PVL #6)

Verified: YES

Professional Team Comments:

Reviewed details of the ZIP Code database update.

Reviewed process for validating ZIP Codes on data provided by vendor.

Reviewed changes in the current ZIP Code database release. Reviewed maps of ZIP Code polygons and ZIP Code centroids.

Documentation reviewed:
  ▪ Hurloss Risk Analysis Suite, Terrain Database, Volume III-B

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 and loss costs). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model would not meet this Standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.

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

Verified: YES

Professional Team Comments:

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

G-5 Editorial Compliance*

(*New Standard)

All documents 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 that the submission has been personally reviewed.

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, 2007*.

2. Describe all changes to the submission document since the prior year's submission that might impact the final document submission.

3. Demonstrate that the modeler submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and error free regarding the inclusion of extraneous data or materials. Form G-7 will be reviewed.

Verified: YES

Professional Team Comments:

Discussed with Janet MacKenzie her process for editorial review.

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 were identified. The modeler is responsible for eliminating such errors.

Meteorological Standards – Tom Schroeder, Leader

M-1 Base Hurricane Storm Set*
(*Significant Revision)

A. Model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 1, 2007 (or later), HURDAT as of June 1, 2005 plus the 2005 and 2006 seasons, or HURDAT as of June 1, 2006 plus the 2006 season. Complete additional season increments based on updates to HURDAT 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. Validation and comparison shall encompass the complete Base Hurricane Storm Set as well as any partitions.

Audit

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

2. Reasoning and justification underlying any modification by the modeler to the Base Hurricane Storm Set will be reviewed.

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

4. 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 hurricane frequencies for the four regions of Florida and overall as provided in Form M-1 will be reviewed.

5. 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

8. M-1.A, page 49 – Clarify the second sentence referring to use of the June 2006 HURDAT without updates (i.e. that 2005 is the last year of storms used) with reference to the responses provided for Standard M-1.1 (page 49) and Standard M-2.8 (page 53).

Verified: YES

Professional Team Comments:

Verified that ARA uses HURDAT for model validation.

Reviewed code incorporating 2006 HURDAT data into the model base.

Reviewed code generating parameters for the negative binomial distribution.

Discussed at length differences between the modeled and historical values for landfalling and by-passing hurricane frequencies. (Also relates to M-3.)
- ARA modeled storms have lower windspeeds than those in HURDAT at landfall for the same central pressure.
- Discussed recent work (previously reviewed and in press) on behavior of Holland B parameter at landfall.
- Reviewed comparisons of modeled and observed central pressure at landfall plotted versus storm recurrence period.
- Landfall frequency distributions pass statistical tests relative to Saffir-Simpson categories and number of storms per year.
- Effects of landfall wind strength also reflected in Form A-3 through historical storms with zero or minimal losses.

Documentation reviewed:
- Vickery, P.J., Wadhera, D., Twisdale, L.A. Jr., Lavelle, F.M., 2008: United States Hurricane Wind Speed Risk and Uncertainty. ASCE Journal of Structural Engineering. (submitted)
- Vickery, P.J. and Wadhera, D., 2008: Statistical Models of Holland Pressure Profile Parameter and Radius to Maximum Winds of Hurricanes from Flight Level Pressure and H*Wind data. Journal of Applied Meteorology and Climatology. (in press)

Reviewed comparison of modeled and observed (1900-2006) central pressures at landfall plotted versus return period.

M-2   Hurricane Parameters and Characteristics*
*(*Significant Revision due to new Disclosures and Audit language)*

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, strike probabilities, tracks, the spatial and time variant windfields, and conversion factors, shall be based on information documented by 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:
    - the data set basis for the fitted distributions,
    - the modeled dependencies among correlated parameters in the windfield component and how they are represented,
    - the asymmetric nature of hurricanes,
    - the fitting methods used and any smoothing techniques employed.

3. The goodness-of-fit of distributions to historical data will be reviewed.

4. The treatment of uncertainties associated with the conversion of gradient winds to surface winds will be compared with currently accepted literature. Variation of the conversion factor with storm intensity will be reviewed.

5. All modeler cited scientific literature provided in Standard G-1 will be reviewed to determine applicability.

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

7.   Describe the value(s) of the far-field pressure used in the model and approximate its sensitivity on the average annual zero deductible statewide loss costs.

Pre-Visit Letter

9. M-2, page 51 – Define V_s in equation (2).

10. M-2, page 51 – Define the functional form of the new ocean mixing and vertical shear terms in equation (2).

11. M-2, page 61 – Provide details of the Holland B parameter model. Provide an example case demonstrating the use of flight data to determine Holland B.

12. M-2, Disclosure 1, page 52 – Clarify time period of data used to develop the Holland pressure profile (b) model.

13. M-2, Disclosure 2, page 52 – Clarify the role of terrain in modifying the windfield in Florida.

14. M-2, Disclosure 3, page 52 – Specify the distributions assumed for the remaining error terms in equations (1) and (2).

15. M-2, Disclosure 5, page 53 – Explain how Kepert's (2001) theoretical result is used to derive the vertical distribution of winds in this model.

16. M-2, Disclosure 5, page 53 – Discuss the specification of the boundary layer depth and whether it varies from water to land. What factors affect the choice of depth?

17. M-2, Disclosure 5, page 53 – Identify factors used to convert boundary layer depth-averaged winds to surface (10 m) winds.

Verified: YES

Professional Team Comments:

Discussion of pre-visit letter items led to submission of several revised pages.

Reviewed definitions of variables in equation (2), page 51. V_s is the scale vertical shear of the horizontal wind defined as the ratio of the (850 mb to 250 mb) shear to the sine of the latitude. Relative intensity varies inversely with wind shear. Reviewed the mathematical formulation of the mixed-layer model. Verified no change from last year.

Reviewed details of the Holland B parameter. Verified no change from last year. Reviewed recent (in press) paper on Holland B (see documentation under M-1).

Discussed the adjustment to windspeed from the basic open terrain input value to the local terrain value using the ESDU models as needed.

Discussed the error terms in equations (1) and (2).

Discussed vertical distribution of mean boundary layer windspeed described in Vickery et al. (2008). Kepert's model is only used as supporting evidence for model results. Model can produce super-gradient winds.

Discussed appropriate values for far-field pressure.   Far-field pressures associated with significant historic intense storms were higher than standard values.   Discussed relevant far-field pressures used in other tropical cyclone basins.   Discussed approximate impact on loss costs of a 1 mb change in far-field pressure.

Reviewed plot of central pressure as a function of vertical wind shear.

Documentation reviewed:
- Vickery, P.J., Wadhera, D., Powell, M.D., and Chen, Y., 2008: A Hurricane Boundary-Layer and Wind Field Model for Use in Engineering Applications. Journal of Applied Meteorological and Climatology. (accepted for publication)
- HurLoss Risk Analysis Suite, Hurricane Model, Volume I-A.

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 probabilities 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).

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 modeler specific research performed to develop the functions used for simulating model variables or to develop databases.

Pre-Visit Letter

18. M-3, Disclosure 2, page 55 – Clarify whether aircraft data were also used in developing Rmax.

Verified: YES

Professional Team Comments:

Discussed the use of flight level data in development of Rmax.

Discussion of hurricane landfall probabilities under Standard M-1 applies to M-3.

M-4   Hurricane Windfield Structure*
*(*New Standard)*

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

B. The translation of land use and land cover or other source information to geographic surface roughness distribution shall be consistent with current state-of-the-science.

Audit

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

2. Provide any modeler-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. Identify other variables in the model that affect over-land surface windspeed estimation.

5. Provide detailed comparisons of the model windfield with Hurricane Charley, Hurricane Katrina, and Hurricane Wilma.

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

7. Form M-2 will be reviewed.

Pre-Visit Letter

19. M-4, Disclosure 1, page 56 – Provide examples of wind radii corresponding to five different (Vmax, Rmax) combinations for both the largest and smallest pressure profile parameter used for the stochastic storm windfield, demonstrating consistency of wind radii with Form M-3.

20. M-4, Disclosure 7, page 57 – Describe the methodology for converting land use and land cover data into roughness length distribution. Provide an example of the use of satellite imagery to refine the conversion of land use and land cover data into roughness length distribution.

21. M-4, Disclosure 7, page 57 – Describe how roughness length impacts the gust factor used to convert to 3-second gust from the mean surface windspeed simulated by the model.

22. M-4, Disclosure 9, page 58 – Provide examples of spatial windfield validation for Hurricanes Charley, Katrina, and Wilma.

24. Form M-2, pages 69-70 – Be prepared to discuss inland ZIP Codes with higher windspeeds than surrounding ZIP Codes. Provide maps of land use and land cover data over Florida and demonstrate the conversion of this information to roughness length, Z_o.

Verified: YES

Professional Team Comments:

Much of discussion of land use land cover conversion occurred under Standard G-1, Disclosure 5.

Reviewed the land use land cover data update using the full National Land Cover Database (NLCD) 2001 LULC produced by the Multi-Resolution Land Use Consortium (MRLC). Discussed the reclassified land use land cover classes from the 1992 Water Management District data.

Reviewed calculation of z_0, surface roughness, by ZIP Code. Reviewed z_0 values by region and by county by class. Reviewed percent of tree canopy calculation applied to the land use land cover. Reviewed adjusted mappings and area weighting calculations.

Reviewed maps of land use land cover data over Florida.

Reviewed scatter plot of changes in surface roughness values from 2005 to 2007. Reviewed color-coded map of terrain roughness values by ZIP Code.

Discussed surface roughness values for adjacent states, which are incorporated in one database.

Reviewed map of surface roughness, z_0 ratio change from 2005 to 2007.

Reviewed plot of ZIP Code area comparison from the land use land cover dataset.

Documentation reviewed:
- Development of Surface Roughness Values using NLCD 2001 Data and 2007 ZIP Codes
- HAZUS Technical Manual
- Hurloss Risk Analysis Suite, Terrain Database, Volume III-B

Reviewed plot of examples of azimuthally averaged horizontal windspeeds.

Reviewed Form M-3 results.

Discussed how roughness length impacts the gust factor used to convert to 3-second gust from the mean surface windspeed simulated by the model. Given z_0 and the mean windspeed, the 3-second gust speed is computed using the ESDU gust factor model.

Reviewed spatial windfield validation examples for Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005). Reviewed 2-D windfield plots of Hurricane Frederic (1979), Hurricane Elena (1985), Hurricane Hugo (1989), Hurricane Bob (1991), Hurricane Andrew (1992), Hurricane Erin (1995), Hurricane Opal (1995),   Hurricane Bertha (1999), Hurricane Fran (1996), Hurricane Bonnie (1998), Hurricane Georges (1998), Hurricane Floyd (1999), Hurricane Irene (1999), Hurricane Isabel (2003), Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Jeanne (2004), Hurricane Dennis (2005), Hurricane Katrina (2005), and Hurricane Rita (2005).

Reviewed results provided in Form M-2. Higher inland windspeeds in the stochastic maps are due to reduced terrain roughness at the inland ZIP Codes.

M-5   Landfall and Over-Land Weakening Methodologies*
*(*Significant Revision)*

A. The magnitude of land friction coefficients shall incorporate current geographic surface roughness distributions and shall be implemented with appropriate geographic information system data.

B. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records.

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 strike probabilities 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 – 130	Extensive
4	131 – 155	Extreme
5	Over 155	Catastrophic

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. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed.

Pre-Visit Letter

23. M-5.A, page 59 – Clarify the use of Florida Water Management District land use and land cover data.

Verified: YES

Professional Team Comments:

M-5.A covered under extensive discussion of land use land cover applications under G-1, Disclosure 5 and M-4.

Verified no change in over-land weakening rate methodology.

Discussed transition of winds from over-water to over-land. Verified no changes.

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 and the modeler's sensitivity analyses provide the information used in auditing this Standard.

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

Pre-Visit Letter

25. Form M-3, page 71 – Explain the radii values for the Pmin bands.

Verified: YES

Professional Team Comments:

Reviewed results provided in Form M-3. A corrected Form was provided with the values provided in the correct order and with a box plot included as required.

Form M-3 results were used in evaluation of Vmax and Rmax in response to pre-visit letter item 19.

VULNERABILITY STANDARDS – Fred Stolaski, Leader

V-1   Derivation of Vulnerability Functions

A. Development of the vulnerability functions is to be based on a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. Any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, or historical data.

B. The method of derivation of the vulnerability functions shall be theoretically sound.

C. Any modification factors/functions to the vulnerability functions or structural characteristics and their corresponding effects shall be clearly defined and be theoretically sound.

D. Construction type and construction characteristics shall be used in the derivation and application of vulnerability functions.

E. In the derivation and application of vulnerability functions, assumptions concerning building code revisions and building code enforcement shall be justified.

F. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and additional living expense.

G. The minimum windspeed that generates damage shall be reasonable.

Audit

1. 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. To the extent that historical data are used to develop vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete structural calculations shall be presented so that a variety of different structure types and construction characteristics may be selected for review. The basis for expert opinion and original site inspection reports shall be available for review.

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

3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and additional living expense shall be available. The magnitude of logical changes among these items for a given windspeed shall be explained and validation materials shall be available.

4. Justify the construction types and characteristics used, and provide validation of the range and direction of the variations in damage.

5. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement.

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

7. Form V-1 will be reviewed.

Pre-Visit Letter

26. V-1, Disclosure 2, page 75 – Provide additional details on insurance data. Were these data related to any rate filings involving the ARA model?

27. Form V-1, Part B, page 80 – Discuss close range of values in "Estimated Damage/Subject Exposure" for the various construction types.

Information presented to the Professional Team:
- V-1.D, page 74 – These data and assumptions have been discussed with the Professional Team.
- V-1.F, page 74 – Example comparisons of modeled and observed appurtenant structure losses for those cases where reliable data are available have been shown to the professional team.
- V-1.5, page 76 – Examples of the number of categories or building classes considered in loss projection studies have been reviewed with the professional team.

Verified: YES

Professional Team Comments:

Discussed new insurance data received from several insurance companies. Review of this data is underway and should be incorporated into the model and verification next year.

Discussed results provided in Form V-1 and the impact of the low strength reference structure items such as nailing and roof-to-wall connections on the damage values.

Verified no change to the vulnerability functions.

Discussed use of new Florida Building Code and possible effects on building stock and model.

V-2   Mitigation Measures

A. Modeling of mitigation measures to improve a structure's wind resistance and the corresponding effects on vulnerability shall be theoretically sound.   These measures shall include fixtures or construction techniques that enhance:

- *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 shall be empirically justified both individually and in combination.

Audit

1. Forms V-2 and V-3 provide the information used in auditing this Standard.

2. Individual mitigation measures as well as total 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.

3. 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.

Information presented to the Professional Team:
- Details of the model have been disclosed to the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed results provided in Form V-2 and Form V-3 (Trade Secret List). Reviewed Excel spreadsheets used to generate Forms V-2 and V-3.   Verified with actual calculations that Form V-2 entries were consistent with the values in Form V-3.

Discussed magnitude of "Mean Damage Ratios" at high windspeeds for frame and masonry structures in Form V-3.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1   Modeled Loss Costs

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

Audit

1. The model will be reviewed to determine that the definition of an event in the model is consistent with Standard A-1.

2. The model will be reviewed to determine that by-passing storms and their effects are considered in a manner that is consistent with Standard A-1.

Pre-Visit Letter

28. A-1, Disclosure 1, page 85 – Provide details relative to the declaration of a hurricane in this response.

Verified: YES

Professional Team Comments:

Verified no change in the model definition of landfalling hurricanes and by-passing storms.

Discussed removal of declaration of a hurricane event.

A-2   Underwriting Assumptions

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

B. For loss cost estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) claim payment practices, and (4) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be appropriate.

Audit

1. Demonstrate how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify model calculations. For example, the level of damage the insurer considers a loss to be a "total loss." Provide the methods used to delineate among the insurer claim practices in the use of historical claims data to verify model outputs.

Verified: YES

Professional Team Comments:

Verified with Doug Collins that the 2004 insurance claims data has not been incorporated in the current version of the model. The Professional Team expressed to the modeler and Doug Collins its concerns that this data has yet to be incorporated in the model nor has it been used to validate the model.

A-3   Loss Cost Projections

A. Loss cost projections produced by hurricane loss projection models shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

B. Loss cost projections shall not make a prospective provision for economic inflation.

Audit

1. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, and economic inflation.

Verified: YES

Professional Team Comments:

Verified that the method for producing loss costs has not changed and does not include any of the prohibited items listed in this Standard.

A-4   Demand Surge

A. Demand surge shall be included in the model's calculation of loss costs using relevant data.

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

Audit

1. Provide the data and methods used to determine the effects of demand surge.

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

Pre-Visit Letter

29. A-4, Disclosure 1, page 89 – Provide details of the multiplicative demand surge factor.

Information to be presented to the Professional Team:
  ▪ Additional details will be provided to the Professional Team. (PVL #29)

Verified: YES

Professional Team Comments:

Reviewed the methodology for calculating the multiplicative demand surge factor.

Verified no change in the demand surge model from the previous year.

A-5   User Inputs

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

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 insurer inputs and assumptions will be reviewed.

Information presented to the Professional Team:
- A-5, page 91, Assumptions/Defaults: Details have been shown to the Professional Team.
- A-5.2, page 91 – Model input requirements are documented in the HurLoss User Manual, which has been reviewed with the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed how the new FHCF exposure data was processed. Discussed handling of roof shape data supplied in the FHCF exposure data. Discussed the process for validating and inputting data.

Reviewed computer code for ingesting zero and multiple risk counts.

A-6   Logical Relationship to Risk

A. *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.*

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

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

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

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

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

G. *The relationship of loss costs for individual coverages, (e.g., structures and appurtenant structures, contents, and loss of use/additional living expense) shall be consistent with the coverages provided.*

Audit

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

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

3. Individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, and A-5 will be used to assess coverage relationships.

Pre-Visit Letter

30. A-6.E, page 95 – Provide examples of cases where building code enforcement is quantified in specific structural or building parameter terms, and demonstrate how the model shows that loss costs decrease for stronger/higher quality construction, all other factors held constant.

34. Form A-2, pages 113-114 – The maps will be reviewed with regard to logical relation to risk and Form M-2.

35. Form A-3, Excel file – Explain ID of "zero" for 1909 storm NoName 8.

Verified: YES

Professional Team Comments:

Reviewed example of the distribution of roof-to-wall connection types (e.g., strap versus toe-nail). Discussed assumptions made relative to building code compliance.

Reviewed Form A-2 maps and the impact on loss costs of the surface roughness.

Reviewed Form A-3 results.

Discussed with Doug Collins his review and assessment of the various Forms.

Reviewed discussions between Doug Collins and the modeler regarding sensitivity of the surface roughness changes on the loss costs.

A-7   Deductibles and Policy Limits

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

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

2. 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. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for handling deductibles and policy limits.

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

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

Pre-Visit Letter

31. A-7, Disclosure 1, page 97 – Describe the fast-running loss functions that enable direct computations for deductibles within the simulations.

32. A-7, Disclosure 2, pages 97-98 – Provide the insurance data used to validate the approach.

Information presented to the Professional Team:
- A-7.A, page 97 – The details of this approach and validation have been presented to the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the derivation of fast-running loss functions with deductibles and the data flow chart.

Reviewed plot of limit-capped ground-up losses and loss functions for various deductibles. Reviewed analyses and testing of various deductibles.

Discussed application of deductibles to modeled losses.

Verified no changes in the model relative to applying deductibles and policy limits from the previous year.

A-8   Contents

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

B. *The relationship between the modeled structure and contents loss costs shall be reasonable, based on the relationship between historical structure and contents losses.*

Audit

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for contents coverage.

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

3. Justify changes from the prior submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Verified: YES

Professional Team Comments:

Verified no changes made in the model relative to contents losses from the previous year.

A-9   Additional Living Expense (ALE)

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

B. *ALE loss cost derivations shall consider the estimated time required to repair or replace the property.*

C. *The relationship between the modeled structure and ALE loss costs shall be reasonable, based on the relationship between historical structure and ALE losses.*

D. *ALE loss costs produced by the model shall appropriately consider ALE claims arising from damage to the infrastructure.*

Audit

1. The actuary for the modeler may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for ALE coverage. Documentation and justification of the following will be reviewed:
    a. The method of derivation and data on which the ALE vulnerability function is based;
    b. Validation data specifically applicable to ALE;
    c. Assumptions regarding the coding of ALE losses by insurers;
    d. The effects of demand surge on ALE for Hurricane Andrew;
    e. Assumptions regarding the variability of ALE by size of property;
    f. Statewide application of ALE assumptions;
    g. Assumptions regarding ALE 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 ALE costs.

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

3. Justify the differences in the relationship of structure and ALE loss costs from those previously found acceptable.

Pre-Visit Letter

33. A-9.B, page 100 – Describe the process used to determine when the physical damage sustained to the building is significant enough such that the building is unlivable.

Verified: YES

Professional Team Comments:

Discussed the basis for ALE.

Reviewed results in Figure 20 and questioned the modeler regarding the potential outliers.

Verified no changes made in the model relative to ALE losses from the previous year.

A-10 Output Ranges

A. Output ranges shall be logical and any deviations supported.

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

1. masonry construction versus frame construction,

2. residential risk exposure versus mobile home risk exposure,

3. in general, inland counties versus coastal counties, and

4. in general, northern counties versus southern counties.

Audit

1. Forms A-6A, A-6B, A-7, and A-8 will be reviewed.

2. The modeler will be required to justify all changes from the prior submission using the 2002 Florida Hurricane Catastrophe Fund aggregate exposure data.

3. Output ranges will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.

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

Pre-Visit Letter

36. Form A-7, page 202 – Discuss values for "North" region for all types of construction and deductibles.

37. Form A-8, pages 203-206 – Discuss the extreme values (84-100%) and their geographic distribution.

Verified: YES

Professional Team Comments:

Discussed the difference in contents loss costs between Monroe and Miami-Dade counties in light of changes made to the surface roughness factors. Reviewed color-coded maps of loss costs by county.

Reviewed the extreme values for renters and condo unit owner policies in Baker County. Discussed these policies being dominated by contents losses and the changes in small absolute values resulting in large percentage changes.

Reviewed the changes in loss costs and discussed values for "North" region for all types of construction and deductibles.

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 agreement using currently accepted scientific and statistical methods in the appropriate disciplines.**

Audit

1. Forms S-1 and S-2 will be reviewed.

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

Pre-Visit Letter

38. S-1, Disclosure 4, page 209 – Confirm that no post-1998 insurance data has been used to validate the model.

Verified: YES

Professional Team Comments:

Verified negative binomial distribution fits for number of events per year in the Atlantic basin.

Determined that no validations have been performed using post-1998 claims data on the current version of the model. The Professional Team expressed its concerns to the modeler about delaying the incorporation of the 2004 claims data in the model.

Documentation reviewed:
- Florida Hurricane Model – Validation Results, Statistical Tests, Verification, and Testing Results

Reviewed return period plots of central pressure by landfall location.

Verified revised wording changes to various Disclosures.

S-2   Sensitivity Analysis for Model Output

The modeler 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 modeler'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-5 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Information presented to the Professional Team:
- S-2, page 211 – The sensitivity study results have been presented to the Professional Team.
- S-2.3, page 212 – Additional examples showing the impact of the different parameters used in the model on loss cost estimates have been presented to the Professional Team during past visits.

Verified: YES

Professional Team Comments:

Changes to model did not necessitate update to Form S-5. No change from the previous submission.

Reviewed a sensitivity test on surface roughness (z_0). Reviewed plot of change in owner frame ground-up AAL due to a 10% increase in surface roughness.

S-3   Uncertainty Analysis for Model Output

The modeler 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 modeler'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-5 will be reviewed for models submitted by modeling organizations which have not previously provided the Commission with this analysis.

Information presented to the Professional Team:
- S-3, page 214 – An uncertainty analysis has been performed and has been presented to the Professional Team.

Verified: YES

Professional Team Comments:

Changes to model did not necessitate update to Form S-5. No change from the previous submission.

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:

Reviewed spreadsheet of standard errors by county. Verified no change in the process of sample size determination.

Verified that the sample size achieves the 2.5% bound on the standard error of each output range.

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 modeler. This Standard applies separately to personal residential and, to the extent data are available, to mobile homes. 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.

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:

        i.   Personal versus commercial
       ii. Residential structures
      iii. Mobile homes
      iv. Condominiums
       v. Structures only
      vi. 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-3 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

39. S-5, Disclosure 1, page 218 – Present the data in Figure 40 as a plot of actual versus modeled loss ratios (retaining the pairing of the data).

Information presented to the Professional Team:
- S-5, page 217 – Additional details on actual and modeled ZIP Code level losses have been presented to the Professional Team.
- S-5.1, page 218 – Other intermediate results for damage estimation have been shown to the Professional Team.

Verified: YES

Professional Team Comments:

Traced calculations of correlation values derived from Figure 39.

Reviewed plot of actual loss ratios versus modeled loss ratios constructed from data in Figure 40.

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-4 will be reviewed.

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

Pre-Visit Letter

40. Form S-4, Part A, page 227 – Explain current year versus previous year for "Produced by Model" results.

Verified: YES

Professional Team Comments:

Reviewed full values for last year and this year and verified they are the same to 3 significant digits.

Verified that revised Figure 42 was correct.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1   Documentation

A. *The modeler shall maintain a primary document binder, containing a complete set of documents specifying the model structure, detailed software description, and functionality. Development of each section shall be indicative of accepted software engineering practices.*

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

C. *Documentation shall be created separately from the source code.*

Audit

1. The primary document binder, in either electronic or physical form, and its maintenance process will be reviewed. The binder shall contain fully documented sections for each Computer Standard.

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

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

4. Modeler 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 the source code.

6. A table for each item listed in Standard G-1, Disclosures 5 and 6 will be reviewed. The table 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, C-3, C-4, C-5, and C-6.

7. Trace the model changes specified in Standard G-1, Disclosures 5 and 6 through all Computer Standards.

Verified: YES

Professional Team Comments:

Reviewed the revised documentation for the two equations that define adjusting the mapping related to the z_0 calculation.

Reviewed the extensive documentation defining all aspects of the new MRLC NLCD 2001 terrain data used for this year's submission.

Reviewed the Hurloss Risk Analysis Suite, Primary Document Binder.

Reviewed the revised document "Development of Surface Roughness Values using NLCD 2001 Data and 2007 ZIP Codes" and the updated binder in which it resides.

Reviewed the table required by Standard G-1, Audit item 6.

C-2   Requirements

The modeler shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component.

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.

Verified: YES

Professional Team Comments:

Reviewed "General Requirements for ARA Models."

Reviewed the revised requirements documentation related to:
  1) the changed land use land cover approach and data
  2) the ZIP Code database update
  3) the updated table to include the 2006 storms

C-3   Model Architecture and Component Design

The modeler shall maintain and document (1) detailed control and data flow diagrams and interface specifications for each software component, and (2) schema definitions for each database and data file.   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.

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

Verified: YES

Professional Team Comments:

Reviewed the original flow chart calculation procedure for determining z_0 by ZIP Code.

Reviewed the revised, annotated flow chart describing the calculation of z_0 after the first flow chart was found to be in error.

Reviewed the Derivation of Fast-Running Loss Functions with Deductibles data flow chart.

Reviewed the Model Architecture and Component Design document related to (1) hurricane simulation, (2) individual building damage and loss methodology, and (3) portfolio analysis.

C-4   Implementation

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

B. The modeler 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 modeler 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 modeler shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosures 5 and 6:

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, and

      e.   input and output parameter definitions.

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

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

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

Verified: YES

Professional Team Comments:

Reviewed the use and implementation of the MRLC NLCD 2001 data for land use land cover processing.

Reviewed the LULC to z_0 mapping table and associated spreadsheet calculations.

Reviewed the spreadsheet formulas used to create the adjusted mapping for two roughness calculations involving developed, open space and developed, low intensity regions.

Reviewed the use of the Access query language to modify, merge, and manipulate land use land cover data to create one record per ZIP Code.

Reviewed the storm file updated Fortran code to include the 2006 storms.

Reviewed the Fortran code used to read storm tracks and to calculate the parameters for the negative binomial distribution.

Reviewed the Fortran code used to generate the stochastic storm tracks.

Reviewed the revised code statistics table required by Standard C-4.D.

Reviewed the equation and cross-referenced variable table required by Standard C-4.F.

Reviewed the added comments to the negative binomial Fortran code. These comments included a new module header in addition to descriptive inline comments.

Reviewed the modeler's coding guidelines for Fortran and C++.

Reviewed Fortran code used to create the output ranges referenced by Standard A-10, Form A-6.

C-5   Verification

A. General

For each component, the modeler 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 modeler personnel other than the original component developers.

B. Component Testing

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

2. *The modeler 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 modeler 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.

Pre-Visit Letter

41. C-5.A, page 236 – Provide a statement to the effect that verification tests have been performed by modeler personnel other than the original component developers *for each* component.

42. C-5.A, page 236 – With reference to the February 27, 2008 letter from ARA to Dr. Randy E. Dumm, provide a detailed discussion of the verification processes used to (1) identify the bug in the commercial GIS software package, and (2) create the work-around to produce correct results.

Verified: YES

Professional Team Comments:

Reviewed the verification checks used by the modeler with regard to the faulty third-party GIS calculations resulting in initially incorrect ZIP Code roughness values, and a delayed submission on March 7, 2008. The modeler created a workaround, present in the current submission, that involved two steps: (1) using the entire image files from MRLC NLCD 2001 instead of masked images, and (2) processing only the ZIP Codes that intersected the NLCD 2001 image file in areas of relevant land use land cover data.

Reviewed several color-coded state and ZIP Code plots to verify the reasonableness of the land use land cover data by ZIP Code.

Reviewed the data verification approach used to check the adequacy of the ZIP Code roughness calculation on the boundary between two separate land use land cover regions in Florida.

Reviewed the manual approach used to visually verify ZIP Code centroid and roughness value changes from the prior year's submission.

Reviewed the modeler procedure for ensuring that verification procedures included tests performed by modeler personnel other than the original component developers. In particular, the modeler discussed this verification approach associated with the GIS software bug found by the modeler and reported to the GIS software developer ESRI.

C-6 Model Maintenance and Revision

A. The modeler 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 shall result in a new model version number.

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

Audit

1. All policies and procedures used to maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, the modeler shall provide the installation date under configuration control, the current version number, 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.

Verified: YES

Professional Team Comments:

Reviewed the use of SourceSafe to manage source code, data, and documentation changes.

Reviewed the use of SourceSafe to manage the revision history of changes to the document "Development of Surface Roughness Values using NLCD 2001 data and 2007 ZIP Codes."

Reviewed the ARA Policy for Model Revision.

Reviewed the rules used by the modeler for model and code version numbering.

C-7   Security

The modeler 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 changes from the prior year's submission with regard to security procedures.

Reviewed the modeler's policies with regard to security of code, data, and documentation.