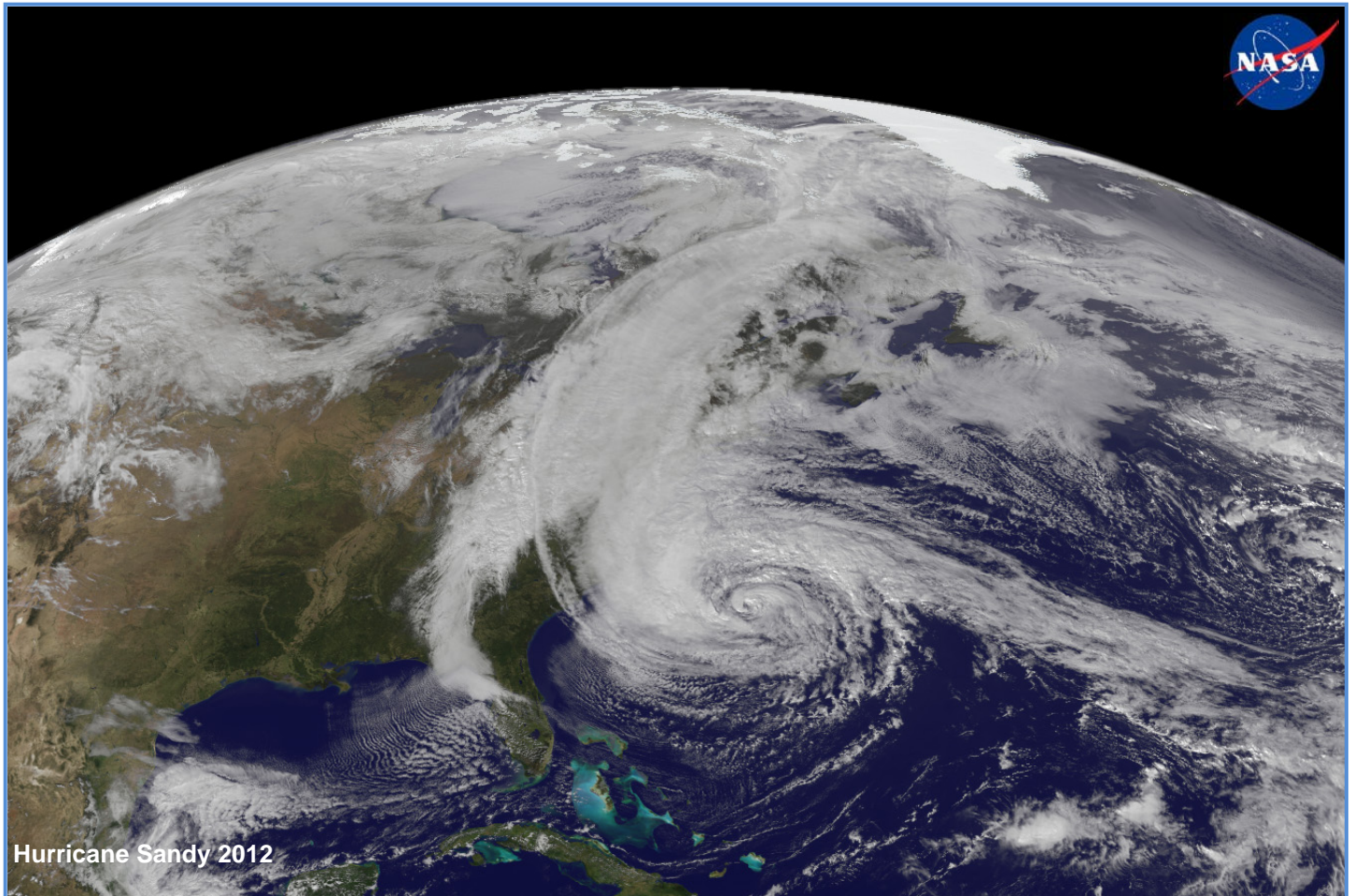


Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report 2011 Standards

Risk Management Solutions, Inc.

**On-Site Review
February 5-7, 2013**

**Additional Verification Review
May 14, 2013**

On February 5-7, 2013, the Professional Team visited on-site at Risk Management Solutions, Inc. (RMS) in Newark, California to review RiskLink version 13.0. The following individuals participated in the review:

RMS

Enrica Bellone, Ph.D., Director Model Product Management
Kay Cleary, FCAS, MAAA, FCA, Actuary & Director
Peter Datin, Senior Catastrophe Risk Modeler
Mark Dixon, Ph.D., Lead Modeler
Michael Drayton, Ph.D., Consultant
Alison Dobbin, Senior Catastrophe Risk Modeler
Steve Jewson, DPhil, Vice President Climate Hazard Model Development
Pratiksha Kadam, Principal Software Engineer
Petros Keshishian, Director, Model Development
Shree Khare, Ph.D., Director, Modeling
Swaminathan Krishnamoorthy, Director, Software Engineering
Thomas Loridan, Ph.D., Senior Catastrophe Risk Modeler
Joss Matthewman, Ph.D., Senior Catastrophe Risk Modeler
Charles Menun, Ph.D., P.E., Consultant
Mohsen Rahnama, Ph.D., Senior Vice President Model Development
Ambica Rajagopal, Ph.D., Lead Financial Modeler
Agustin Rodriguez, Principal Modeler, Model Development
Chris Sams, Senior Geospatial Modeler, Geospatial Development
Pooya Sarabandi, Ph.D., P.E., Director Model Development
Emilie Scherer, Senior Catastrophe Risk Modeler
Slava Sigal,, Ph.D., Lead Financial Modeler
Ajay Singhal, Ph.D., Vice President SW Engineering
Rajesh K. Singh, Ph.D., P.E., Senior Director, Model Certification
Michael Smith, Ph.D., Senior Catastrophe Risk Modeler
Beth Stamann, Senior Documentation Specialist
Cody Stumpo, Senior Product Manager
Bill Suchland, Vice President Geospatial Development
Joel Taylor, CCRA, Manager Model Product Management
Rajkiran Vojjala, Manager, Model Development
Paul Wilson, Director, Modeling
Michael Young, M.E.Sc., P.E., Senior Director Model Product Management

Professional Team

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

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

On October 30, 2012, RMS notified the Commission of “an error in the RMS North Atlantic Hurricane Model, RiskLink 11.0.SP2 submission.” RMS stated they “identified an issue with the annual deductible factors used in completing the RiskLink 11.0.SP2 submission.” The following revised forms under the 2009 Standards were submitted along with an explanation of the issues and the corrective actions taken.

- Form A-1 (Personal Residential Loss Costs)
- Form A-6 (Output Ranges)

The audit opened with an explanation by RMS of the annual deductible factors error that was discovered while preparing Form A-4 (Output Ranges) for the current submission and the subsequent actions taken to prevent this error from occurring again. Discussion centered around the root cause analysis performed, communication to clients, testing and updating of the annual deductible factors table that is provided to clients along with the model software package. The updated QA process was reviewed.

The Professional Team recommends that the Commission rescind the acceptability of RiskLink version 11.0.SP2 since this version of the model includes incorrect annual deductible factors and should not be used by clients in a rate filing. The Professional Team informed RMS that the model version number must be revised for the model software with the corrected annual deductible factors supplied to clients in accordance with Standard C-6.

Since the model version number has been determined to be RiskLink version 11.0.SP2c, and all pertinent forms revised accordingly, the Professional Team (or a subset thereof) will review this material for consistency with this revised model number. The Professional Team expects but cannot guarantee that the revised version will be acceptable.

RMS notified the Professional Team of two new errors discovered that necessitated a rerun of the output ranges (Form A-4). 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 will not be verified during the initial on-site review. Other standards also cannot be verified pending the review of Form A-4 (Output Ranges).

The first error relates to reverse geocoding where user defined latitude/longitude coordinates are treated as exact locations and assigned a ZIP Code in order to designate the appropriate vulnerability or inventory regions. The reverse geocoding is used in the logical relationship to risk Forms A-6 and A-7. The bug in the geocoding software provided by a third party vendor incorrectly assigned 48 of the 938 Grid B ZIP Codes which impacted Form A-7. Communications with the third party vendor on the ZIP Code mis-assignments and the follow-up actions to prevent future errors were discussed.

The second error relates to form generation where only one of the four actuarial forms was regenerated after the correction and update to the annual deductible ratio table. Forms A-4, A-5, and A-7 were not regenerated before the submission was produced and are incorrect as provided in the submission. RMS provided revised forms and discussed the changes in the forms from the initial submission using the updated annual deductible factors table. Internal instructions for using the annual deductible table in completing Commission forms and the tests implemented to verify that the correct annual deductible table is used in form generation were discussed.

The Professional Team was unable to verify Standard A-1 (Modeling Input Data) and Standard A-6 (Loss Output). Consequently, G-1 (Scope of the Computer Model and Its Implementation), G-4 (Independence of Model Components), A-3 (Modeled Loss Cost and Probable Maximum Loss Considerations), A-4 (Policy Conditions), C-4 (Implementation), and C-5 (Verification) also could not be verified as they require the verification of the aforementioned two standards. At the exit briefing, modeler options as given in the Report of Activities were presented to the modeler.

RMS followed the error announcements and discussion with a presentation of a module component recap and the changes in RiskLink version 13.0 with the impact of those changes on loss costs.

- New stochastic event set based on updated data from the 2011 version of HURDAT
- Revised historical footprint recreations of seven events based on the HURDAT re-analysis of years 1926-1930 and a revised storm in 1925
- Updated ZIP Code database based on 2011 postal code data
- Revision of “reverse geocoding” methodology to correct assigning ZIP Codes to user-input latitude and longitude coordinates

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:

- Table of Contents, revised to include all figures and tables
- Page 29, G-1, Disclosure 4 revised after correction of Deficiency #3
- Page 83, M-5.B, Figure 25 *x*-axis label corrected
- Page 90, V-1, Disclosure 3 revised for clarity
- Page 94, V-1, Disclosure 11 revised to correct typographical error
- Page 99, V-2.B revised for clarity
- Page 101, V-2, Disclosures 5 & 6 revised to remove reference to deleted figures
- Page 129, A-6, Disclosure 13 link to V-1, Disclosure 13 corrected
- Page 144, Standard C-2 revised for clarity
- Pages 172-175, Form M-1, Figure 46 corrected and Figure 49 added
- Page 307, Appendix B, Mohsen Rahnama’s bio updated

Additional Verification Review – May 14, 2013

RMS submitted revisions to the original November, 2012 model submission under the 2011 Standards on March 12, 2013. The Professional Team completed an additional verification review on May 14, 2013 in Newark.

The following individuals participated in the additional verification review.

RMS

Enrica Bellone, Ph.D., Director Model Development

Kay Cleary, FCAS, MAAA, FCA, Actuary & Director

Shree Khare, Ph.D., Director, Model Development

Swaminathan Krishnamoorthy, Solution Architect-Director, Integration Services

Charles Menun, Ph.D., P.E., Lead Vulnerability Engineer Product Development

Mohsen Rahnama, Ph.D., Senior Vice President Model Development

Chris Sams, Senior Geospatial Modeler, Geospatial Development
Slava Sigal, Principal Modeler
Ajay Singhal, Ph.D., Vice President SW Engineering
Beth Stamann, Senior Documentation Specialist
Joel Taylor, CCRA, Manager Model Product Management
Michael Young, M.E.Sc., P.E., Senior Director Model Product Management

Professional Team

Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Donna Sirmons, Staff

The additional verification review began with a discussion of the outstanding issues. RMS indicated a change was made to Form S-2 since the March 12, 2013 revised submission but no additional changes had been made.

RMS began with a presentation of an event timeline and summary of changes and updates to RiskLink v13.0. Three new issues were presented since the March 2013 initial on-site review:

1. Return Period Loss Annual Deductible Factors
2. Geocoding Update – changes to Forms A-1, A-7, S-2
3. Form S-2 with 4 updates
 - a. New Return Period Loss Annual Deductible Factors included for the FHCF exposure data,
 - b. New postal codes from the 2012 Geocode update,
 - c. Annual Deductible Factors now applied for average annual loss for the FHCF exposure data,
 - d. Median and Interquartile numbers not originally updated from the previous submission.

The Professional Team reviewed all materials in the re-submission that were impacted by the corrections noted previously.

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 17, 2012 meeting. The deficiencies were corrected by the established time frame, and the corrections have been verified. The Professional Team informed RMS the link to V-1, Disclosure 13 provided under A-6, Disclosure 13 in the revised submission documentation was incorrect and that the list of figures and tables given in the Table of Contents is incomplete.

1. None of the links in the submission document are functional.
2. Model Identification (page 9)
Name of Model has a different model name than that given in the response to G-1, Disclosure 1 on page 21.
3. Standard G-1, Disclosure 4 (page 28)
Reference provided in M-5.B (page 76) not listed in List of References.
4. Standard G-1, Disclosure 5.B (page 36)
Response to sub-parts 1 and 2 is missing.
5. Standard G-2, Disclosure 2.A (page 43)
Response is incomplete. Identify the status of Dr. Mark Dixon and Dr. Thomas Loridan in Table 2.
6. Standard V-1.E (page 85)
Response is unclear. Clarify how vulnerability functions are derived separately for appurtenant structures.
7. Standard V-1, Disclosure 13 (page 95)
Response is non-responsive as it does not address the demonstration of consistency of model vulnerability function relationships by type of coverage with actual insurance data.
8. Standard S-1, Disclosure 6 (page 134)
Response is incomplete as the wind profile shape parameters X1 and N are undefined.

Report on Issues

At the conclusion of the additional verification review, the Professional Team subset discussed the following issues identified by the Commission at the December 17, 2012 meeting. The modeler will give a detailed presentation to the Commission on these issues during the trade secret session of the meeting to review the model for acceptability.

1. Development of loss costs in the model and changes in the loss costs from the last change in the model, specifically how the model treats coastal versus inland loss costs. Be prepared to fully explain the process for incorporating changes in the

model including the analyses of the underlying data. More detail to be provided in the presentation and discussion of Form A-5.

2. Describe if the model makes assumptions for adjustor errors or contract ambiguity.

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 2011 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 since 2004, including all data related to the 2004 and 2005 hurricane seasons. 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 review by the Professional Team in 2009. 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 2011 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.

As part of the on-site review, the Professional Team is charged with obtaining information regarding the two issues noted in the deficiency letter that will be later considered during the trade secret portion of the Commission meeting.

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/or 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 (1) located within the model, (2) used to compile data used by the model, (3) used to validate the model, (4) used to project model loss costs and probable maximum loss levels, and (5) 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. Maps, databases, or data files relevant to the modeling organization's submission will be reviewed.
5. 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 for:
 1. All changes combined, and
 2. Each individual model component change.
 - C. For any modifications to Form A-4 since the initial submission, additional versions of Form A-5:

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 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.B, page 21: Illustrate and explain, in detail, the documented process used to comply with Standard G-1.B.
2. G-1, Disclosure 2, page 22: Identify the observed storm whose track parallels the US/Mexico border.
3. G-1, Disclosure 2, page 22: Explain the simulated track that makes it to California.
4. G-1, Disclosure 2, page 24: Discuss the four additional parameters related to the Empirical Orthogonal Functions, including the datasets and assumptions used in their derivation and their role in reducing the modeled windfield variance.

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

Professional Team Comments:

This standard cannot be verified pending verification of Standards A-1 and A-6.

Discussed RMS use of two different source control software packages for documentation and code revisions, the bug tracking system, and internal documentation standards and protocols.

Reviewed track for Hurricane Claudette (2003).

Discussed the stochastic track model which does not explicitly prohibit storms which track inland from the Gulf as far as California and any storms that track far to the west are remnants.

Discussed the windfield calibration procedures to derive the Empirical Orthogonal Functions and the four additional parameters. The Professional Team recommended the presentation be available to the Commission during the Trade Secret session.

Reviewed revised maps for G-1, Disclosure 5 with the minimum and maximum values and locations added.

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

Verified after resolution of outstanding issues with Standards A-1 and A-6.

Reviewed revisions to Disclosure 5 to include the Financial Model update reflecting the application of annual aggregate deductibles to probable maximum loss and the Geocoding update to 2012 postal code vintage data.

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 or any modifications to an accepted model 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 and shall abide by the standards of their profession.**

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, 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 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

5. G-2, Disclosure 2.B, page 48: Resumes for the new employees listed should be available.
6. G-2, Disclosure 3.B, page 51: Explain how the reviews are relevant to the current submission, RiskLink 13.0.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Mark Dixon, Ph.D., Condensed Matter Physics, Warwick; B.Sc. Philosophy & Physics, Keele

- Shree Khare, Ph.D., Program in Atmospheric and Oceanic Sciences, Princeton University; M.S. Program in Atmospheric and Oceanic Sciences, Princeton University; B.S. Honors Physics, University of British Columbia, Vancouver, Canada
- Punit Kumar, B.E., Computer Science
- Thomas Loridan, Ph.D., Numerical Weather Prediction, King's College London, London, UK; M.Sc. Weather Climate and Modeling, University of Reading, UK; Engineering Degree Numerical Modeling, University of Bordeaux, France; Bachelor Pure Mathematics, Mathematics and Physics Preparatory School, Nice, France
- Joss Matthewman, Ph.D., Applied Mathematics, UCL, London, UK; M.Sc. Mathematics
- Michael Smith, Ph.D., Civil Engineering/Mathematics, University of Dundee; B.Sc. Applied Mathematics, University of St. Andrews

Discussed the publications provided in the submission referring to components of RiskLink version 11.0.SP2 are still relevant in version 13.0.

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

G-3 Risk Location

- A. ZIP Codes used in the model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the model. ZIP Code information shall originate from the United States Postal Service.***
- B. ZIP Code centroids, when used in the model, shall be based on population data.***
- C. ZIP Code information purchased by the modeling organization shall be verified by the modeling organization for accuracy and appropriateness.***

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.

Pre-Visit Letter

7. G-3, page 53: Provide the process for incorporating the updated ZIP Codes within the RMS modeling approach.

Verified: YES

Professional Team Comments:

Discussed the methodology for updating and validating ZIP Code centroids.

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

Discussed impact of the geocoding update on Escambia, Gulf, Liberty, and Alachua counties.

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

Discussed the Geocoding Update implemented after RMS geocoding vendor issued new software. This geocoding update resolved the Reverse Geocode issue discovered during the initial on-site review in March.

Reviewed the two new point zips in the Geocoding Update to the 2012 postal code vintage data.

Reviewed geographic displays of the two new ZIP Code centroid locations with comparison to previous locations.

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 Standards A-1 and A-6.

*****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 Standards A-1 and A-6.

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 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 December 31, 2011*.
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 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 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 with Beth Stamann her process and the check list used for editorial review.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

(*Significant Revision)

- A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of August 15, 2011 (or later). 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. 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 HURDAT database are used in the calculation of landfall distribution.
3. Reasoning and justification underlying any modification by the modeling organization to the Base Hurricane Storm Set 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 hurricane frequencies for the four regions of Florida and overall as provided in Form M-1 will be reviewed.
6. Form M-1 will be reviewed for consistency with Form S-1. Changes to the modeling organization's Base Hurricane Storm Set from the previously accepted submission will be reviewed.
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

8. M-1, Disclosure 1, page 57: Discuss the process used to update the Base Hurricane Storm Set from the November 2011 version of HURDAT used and with the addition of the 2011 hurricane season. Provide the list of all storms added or modified.
14. Form M-1, page 171: Justify the distribution of modeled storms, in particular for Regions B, C, and F.
15. Form M-1, page 172: Discuss the changes in track parameters implemented in the update of the Base Hurricane Storm Set.

Verified: YES

Professional Team Comments:

Reviewed the procedure for incorporating and validating updates to the Base Hurricane Storm Set. Verified implementation of the updates to the historical storm set used HURDAT reanalysis through 1930, released in November 2011 and the complete 2011 season from HURDAT May 2012.

Discussed the modeler decision not to use the complete May 2012 HURDAT release, incorporating reanalyses of storms through to 1935.

Reviewed revisions to seven storms incorporating revisions in the 1925-1930 HURDAT reanalysis:

- 1925 storm, decrease in intensity to tropical storm and removal from the Florida set
- 1926 storm, increase in intensity and track update
- 1926 storm, Great Miami storm track update
- 1926 storm, track update and increase in intensity
- 1928 storm, track update
- 1928 storm, Lake Okeechobee storm track update
- 1929 storm, track update and changes in intensity

Reviewed the distribution of modeled storms.

Discussed that no short- or long-term variations are imposed.

Forms M-1 and S-1 were reviewed.

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. All cited scientific literature provided in Standard G-1 will 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 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, Disclosure 3, page 59: Discuss the use of Demuth et al. (2006) in determining the coefficients for the model.
10. M-2, Disclosure 9, pages 61-63: Relate the landfall frequency changes by gate to the new Base Hurricane Storm Set.

Verified: YES

Professional Team Comments:

Discussed the use of Demuth et al. (2006) for the observed wind radii database.

Discussed the landfall frequency changes for landfalling storms by Florida gate.

Verified that distributions of storm parameters are unchanged.

Discussed that surface winds are modeled directly (conversion factors not used).

Reviewed the spatial distribution and variation of far field pressure.

M-3 Hurricane Probabilities

- A. Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.**
- B. Modeled hurricane landfall frequency distributions shall reflect the Base Hurricane Storm Set used for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).**
- C. Models shall use maximum one-minute sustained 10-meter windspeed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm Set used to develop landfall frequency distributions as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter windspeed shall be within the range of windspeeds (in statute miles per hour) categorized by the Saffir-Simpson Scale.**

Saffir-Simpson Hurricane Scale:

Category	Winds (mph)	Damage
1	74 – 95	Minimal
2	96 – 110	Moderate
3	111 – 130	Extensive
4	131 – 155	Extreme
5	Over 155	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 will be reviewed for the probability distributions and data sources.

Verified: YES

Professional Team Comments:

Discussed that quality of fits extend outside of Florida. Discussed that the distributions are unchanged.

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

Discussed method for sampling stochastic storms making landfall.

M-4 Hurricane Windfield Structure

- 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 into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.***
- C. With respect to multi-story structures, 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. Identify other variables in the model that affect over-land surface windspeed estimation.
5. Provide detailed comparisons of the model windfield with Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).
6. For windfield and/or 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 will be reviewed.

Pre-Visit Letter

- 11.M-4, Disclosure 7, page 70: Discuss the currency of the land use land cover database used.
- 12.M-4, Disclosure 7, page 70: Describe the methods used to update the land use land cover database used from the 2001 distributions inherent in the NLCD 2001 database.

16. Form M-2, pages 179-184: Justify the changes in location between actual and open terrain for each time period.

Verified: YES

Professional Team Comments:

Discussed that historical windfield reconstructions should use the windfield profile used for the stochastic storm set and that the hurricane parameters used should fall within the range of values available to the stochastic storms. Discussed that, within these constraints, historical storm reconstructions should provide the modeler's best estimate of the storm's envelope of damaging winds. Discussed that historical reconstructions of windfields for all newly reanalyzed storms, or new storms in HURDAT, will be reviewed in detail. Discussed need for modelers to keep a record of their process used in determining the optimal set of hurricane parameters for each historical storm.

Discussed the methods used to develop the land use land cover database. ASTER imagery is processed and used rather than the NLCD database.

Discussed the 2001-2004 vintage of the land use land cover database.

Discussed the relevance of the inventory distribution to the land use land cover distribution and the modeler decision process for inventory and land use land cover database updates.

Reviewed plot of the spatial distribution of surface roughness used in the model.

Reviewed wind footprint validations for the Great Miami Hurricane (1926) and the Lake Okeechobee Hurricane (1928).

Reviewed spatial distribution of modeled windspeeds compared to observations for Hurricane Jeanne (2004).

Verified no change in the windfield methodology.

Discussed differences in Form M-2 results for actual and open terrain due to different specifications of land use land cover.

Reviewed the empirical orthogonal function (EOF) methodology used for refining the spatial distribution of winds. Discussed the derivation of the "four additional parameters (Standard G-1). Discussed no change from previous submission.

Reviewed in detail the modeler reasoning in setting the storm parameters necessary for the windfield reconstructions of the Great Miami hurricane (1926, NoName7) and the Lake Okeechobee hurricane (1928, NoName4). These hurricanes are the two largest historical losses in the Base Hurricane Storm Set (Form A-2). Discussed in detail modeler methods for evaluating the modeled winds against historical station data. The Professional Team recommends the modeler present this information to the Commission during the Trade Secret session.

Reviewed modeler method for adjusting historical wind observations to “surface” (10-meter) height. Discussed modeler adjustment of 1-minute average windspeeds to gust windspeed. These are reported in knots (nm/hr) in HURDAT and other NOAA/NWS databases, but are displayed in mph. Discussed that factors used in adjustment of 1-minute wind to gust wind are site specific and calculated following the approach used in RiskLink version 13.0.

Reviewed adjustments applied to bring observed and modeled windspeeds to a common reference (10-meter, gust). Reviewed an example of adjusted observations from the Great Miami hurricane (1926) for Miami Weather Service office. Discussed the method used for constructing the exhibit based on an empirical roughness length relationship. Reviewed example of roughness length relationship for two 2004 hurricanes.

Reviewed revised M-2 maps with minimum and maximum values and locations plotted.

M-5 Landfall and Over-Land Weakening Methodologies

- A. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records and with current state-of-the-science.*
- B. The transition of winds from over-water to over-land within the model shall be consistent with current state-of-the-science.*

Audit

1. 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. Provide color-coded snapshot maps of roughness length and spatial distribution of windspeeds over-land and over-water for Hurricane Jeanne (2004), Hurricane Dennis (2005), and Hurricane Andrew (1992) at the closest time after landfall.

Verified: YES

Professional Team Comments:

Reviewed the modeler development of the decay rate distribution for over-land filling. Discussed the dependence of this on storm parameters.

Verified no changes in the model treatment of over-land decay from the previous submission.

Reviewed a histogram comparison of historical and modeled filling rates for selected historical storms including the Great Miami hurricane (1926) and Lake Okeechobee hurricane (1928). Reviewed an updated filling rate comparison for the Great Miami hurricane (1926) based on (1) updated historical data in HURDAT reanalysis, and (2) modeler reconstruction of this hurricane.

Reviewed map of site coefficients and spatial distribution of windspeeds over-land for Hurricane Jeanne (2004) at the time closest to landfall. Discussed the windspeed dependence of the site coefficients.

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 modeling organization's sensitivity analyses provide the information used in auditing this standard.
2. Justify the relationship between central pressure and radius of maximum winds.
3. Justify the variation of the asymmetry with the translation speed.

Pre-Visit Letter

13.M-6, Disclosure 3, page 82: Provide validations of Rmax and gale force wind radius against the Extended Best Track as described here.

Verified: YES

Professional Team Comments:

Reviewed comparisons of the distributions of Rmax and gale radius used in the model with the Extended Best Track database. Discussed that all Extended Best Track wind radii data are used in the comparison unless they are flagged as "extratropical" (and so are no longer tropical).

Verified no change in the treatment of hurricane asymmetry from the previous submission.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

(*Significant Revision)

- A. Development of the vulnerability functions shall be based on any or a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. However, any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, and historical data.**
- B. The method of derivation of the 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, and other construction characteristics, as applicable, shall be used in the derivation and application of vulnerability functions.**
- E. Vulnerability functions shall be separately derived for commercial residential building structures, personal residential structures, mobile homes, appurtenant structures, contents, and time element coverages.**
- F. The minimum windspeed that generates damage shall be consistent with fundamental engineering principles.)**
- G. Vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Vulnerability functions shall not include explicit damage to the structure due to flood, storm surge, or wave action.**

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. For historical data used to develop 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 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 time element coverages 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.
5. Provide validation of the mean vulnerability functions and associated uncertainties.
6. Document and justify all modifications to the 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).
7. Provide validation material for the disclosed minimum windspeed. Provide the computer code showing the inclusion of the minimum windspeed at which damage occurs.
8. The effects on building vulnerability from local and regional construction characteristics and building codes will be reviewed.
9. Describe whether and/or how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify 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.
10. Provide the percentage of damage at or above which the model assumes a total loss.
11. Form V-1 will be reviewed.

Pre-Visit Letter

- 17.V-1.B, page 85: Explain how the uncertainties in vulnerability functions are developed, including the form and basis of the probability distributions around the mean damage ratio for a given windspeed level. Provide examples.
- 18.V-1, Disclosure 2, pages 87-88: Describe the breakdown of loss data among building, content, and time element. Provide any new insurance data received and analyzed since 2007.
- 19.V-1, Disclosure 3, page 90: Explain what is meant by "The CVM enables the objective modeling of vulnerability functions." The component code-based failure loads are used for components vulnerability functions. Provide support for Disclosure 3.

20. V-1, Disclosures 8-14, pages 93-97: Disclosures 8 through 14 are new disclosures for V-1. Prepare to discuss in depth.
21. V-1, Disclosures 8 & 9, pages 93-94: Discuss the basis for not developing vulnerability functions separately for appurtenant structures.
22. V-1, Disclosure 8, pages 93-94: Discuss the basis and the number of distinct content and time element vulnerability functions. Provide examples of content and time element vulnerability functions.
23. V-1, Disclosure 10, page 94: Discuss the weights for developing vulnerability functions for “unknown” and their variation in Florida.
24. V-1, Disclosure 11, page 94: Discuss the development process, examples, and the number of distinct vulnerability functions for commercial residential. Explain what is meant by “interior spaces or contains contained within are damaged.”
25. V-1, Disclosure 12, page 95: Discuss the assumptions regarding insurance company claim payment practices.
31. Form V-1, pages 190-191: Describe the process and provide the documentation for all steps to complete Form V-1. Discuss the reasons why Part A values are the same or have increased relative to the previous submission, and why this increase is shown for concrete and not for wood frame, masonry, and mobile home in Part B.

Verified: YES

Professional Team Comments:

Reviewed the development of the uncertainties associated with the vulnerability functions derived from statistical analyses of historical loss data.

Reviewed graphical comparison of a single-family dwelling mean damage ratio and uncertainty and the mean-to-the-coefficient-of-variation relationship in claims data for Hurricanes Charley (2004) and Wilma (2005).

Reviewed table of loss data by line of business broken down among building, appurtenant structures, content, time element, and undefined. Discussed the use of the undefined class.

Discussed that RMS has not received and analyzed any new insurance data since 2007.

Discussed how the component vulnerability model (CVM) is used in the model to provide an engineering-based approach to confirm the reasonableness of vulnerability functions derived from claims data. Revised response to V-1, Disclosure 3 provided and reviewed.

Discussed the appurtenant structure vulnerability functions are based on appurtenant structure loss data provided by insurance companies and used for the relationship between appurtenant structure damage ratios and building damage ratios.

Discussed vulnerability functions for fences, carports and screen enclosures and how they might be modeled by secondary characteristics.

Discussed the vulnerability regions used to identify the set of vulnerability functions used for calculating losses.

Discussed the inventory regions used to identify weights assigned to a subset of vulnerability functions when there are unknown primary building characteristics.

Reviewed the four vulnerability regions in Florida and the eight inventory regions defined by ZIP Codes. Reviewed the data sources for assigning inventory weights.

Discussed the development of the commercial residential vulnerability functions. Discussed that engineering judgment was significant in the development of the commercial residential vulnerability functions.

Reviewed graphical comparisons of commercial residential with low-rise single family dwelling and office buildings with high-rise vulnerability curves.

Discussed the assumptions regarding company claims payment practices.

Reviewed process used for preparation of Form V-1. Discussed the reasons for the slight increase in loss in referenced concrete building due to opening protection changed from unknown to no shutters.

Reviewed inventory weights database. Discussed inventory database was last updated in 2011.

Due to recent Florida Building Code updates, the Professional Team expressed concern that all construction post-2001 is grouped into a single year-band for vulnerability class.

Discussed the need to update the model with regard to current Florida Building Code.

Discussed audit items 1-5, 7, 9, and 10.

Discussed audit items 6 and 8.

Discussed the need to address regional variations of building stock per applicable codes.

Verified no change in basic vulnerability functions.

V-2 Derivation of Contents and Time Element Vulnerability Functions**(*Significant Revision)*

- A. The relationship between the modeled structure and contents vulnerability functions and historical structure and contents losses shall be reasonable.**
- B. Time element vulnerability function derivations shall consider the estimated time required to repair or replace the property.**
- C. The relationship between the modeled structure and time element vulnerability functions and historical structure and time element losses shall be reasonable.**
- D. 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. 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.
2. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for contents.
3. 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.
4. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for time element.
5. To the extent that historical data are used to develop mathematical depictions of time element functions, demonstrate the goodness-of-fit of the data to fitted models.

Pre-Visit Letter

26. V-2, pages 99-101: Discuss in depth and provide supporting documentation.
27. V-2.A, page 99: Provide plots showing the model relationship(s) between building and contents vulnerability and compare against historical loss data.
28. V-2.B, page 99: Provide the basis and documentation on repair and replacement time.
29. V-2.C, page 99: Provide plots showing the model relationship(s) between building and time element vulnerability and compare against historical loss data.
30. V-2.D, page 99: Explain the response to this standard in relation to the response provided for V-1.E (pages 85-86).

Verified: YES

Professional Team Comments:

Discussed contents vulnerability functions based on contents loss data provided by insurance companies and used to establish a relationship with the building loss data. Reviewed graphical comparison of building damage ratio to contents damage ratio based on loss data from Hurricanes Andrew (1992), Charley (2004), Frances (2004), Jeanne (2004), and Wilma (2005).

Reviewed examples of contents vulnerability functions for two different building constructions.

Discussed the time element loss methodology and the relationship between time element loss ratio and building damage ratio. Reviewed graphical comparison of the time element damage ratio to the building damage ratio based on loss data from Hurricanes Andrew (1992), Charley (2004), Frances (2004), Jeanne (2004), and Wilma (2005).

Reviewed examples of time element vulnerability functions for two different building constructions.

Discussed the repair and replacement times used to calibrate the time element loss model.

Discussed modeled time element losses are a function of the building damage and that time element loss will not be modeled if there is no building damage. Discussed no modeling of indirect losses.

V-3 Mitigation Measures

A. Modeling of mitigation measures to improve a structure'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 structure 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 structure and its contents shall be justified as to the impact on reducing damage whether done individually or in combination.

Audit

1. Form V-2 and Form V-3 (Trade Secret item) provide the information used in auditing this standard.
2. 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.
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.

Pre-Visit Letter

32. Form V-2, page 193: Provide the process and steps taken to complete Form V-2 along with documentation. Compare this form with the previous submission Form V-2. Explain the differences.

Verified: YES

Professional Team Comments:

Reviewed the process for completing Form V-2.

Verified no new mitigation measures were added and no changes to the existing factors.

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

Discussed the factors for mitigation options for wood frame and masonry in Form V-2.

Discussed the factors for the four mitigation options for the reference buildings for high winds individually and in combination.

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/or 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.

Pre-Visit Letter

34.A-1.A, page 109: Describe how errors in insurance company input data are dealt with in relation to the second paragraph in the response.

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

Professional Team Comments:

Model Output Form and Supplement to be revised.

Discussed the application of an annual deductible is on a post-processing basis and has not been reflected on the model output report. All inputs in the model are to be included with the model output report. Modeler agreed to provide a separate page with the output report indicating that the results are based on annual deductibles.

Discussed how errors in insurance company input data are handled by the client.

Verified no change in quality assurance procedures to assure accuracy of insurance data from previous submission.

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

Reviewed additional output report provided in Appendix F to reflect the application of the annual deductible factors.

A-2 Event Definition**(*Significant Revision)*

- A. Modeled loss costs and probable maximum loss levels shall reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.**
- B. Time element loss costs shall reflect losses due to infrastructure damage caused by a hurricane.**

Audit

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

Verified: YES**Professional Team Comments:**

Verified no change in modeled loss costs and probable maximum loss levels reflecting damage from storms making landfall as a hurricane and by-passing storms that generate damaging winds at the coast.

Discussed flood and hurricane storm surge are not included in the loss costs and are produced in a separate model.

A-3 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 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. All referenced literature will be reviewed to determine applicability.

Verified: NO YES

Professional Team Comments:

This standard cannot be verified pending verification of Standards A-1 and A-6.

Discussed the process used by a client for coordinate level geocoding. Reviewed the geocoding user guide "Intro to Geocoding in RMS Applications" and geocoding guidelines to optimize location accuracy.

Verified no change in demand surge methodology.

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

Verified after resolution of outstanding issues with Standards A-1 and A-6.

Discussed RMS research of annual deductible methodology to obtain factors to adjust portfolio probable maximum loss outputs for various return periods.

Reviewed the Return Period Loss Annual Deductible Factors methodology and calculations. The Professional Team recommends the modeler present this new methodology to the Commission during the Trade Secret session, and the application of these factors during the public session.

Reviewed validation curves for two client portfolios. Reviewed validation plot of Return Period Loss ratios modeled versus simulated.

A-4 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: NO YES

Professional Team Comments:

This standard cannot be verified pending verification of Standards A-1 and A-6.

Discussed in detail the development and application of annual deductible factors.

Reviewed how the annual deductible ratios are precompiled and delivered to clients in the annual deductible spreadsheet.

Reviewed the calculations for occurrence deductible and annual aggregate deductible.
Reviewed the corresponding model code.

Reviewed the process and ratios used to convert occurrence deductibles to annual deductible AAL's.

Discussed mathematical depictions of deductibles and policy limits.

Reviewed calculation of the average annual deductibles with reference to the Florida statutes.

Discussed the effects of insurer claims practices.

Verified no change in the process for collecting and analyzing claims data.

Reviewed graphical comparison of the relativities between RiskLink 11.0.SP2 and RiskLink 13.0.

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

Verified after resolution of outstanding issues with Standards A-1 and A-6.

Reviewed Florida annual deductible conversion tool used to compute the annual deductible factors.

A-5 Coverages

- A. The methods used in the development of contents loss costs shall be actuarially sound.***
- B. The methods used in the development of time element coverage loss costs shall be actuarially sound.***

Audit

The methods used to produce contents and time element loss costs will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed plot of claims validation to the contents vulnerability function.

Reviewed plot of claims validation to the time element vulnerability function.

Discussed modeled time element losses are a function of the building damage and that time element loss will not be modeled if there is no building damage. Discussed no modeling of indirect losses.

Reviewed insurance company policies that included language indicating that the time element coverage would not be applied unless the insured property was damaged caused by a covered peril.

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., structures 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.
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, A-2, A-3, A-6, and A-7 will be used to assess coverage relationships.
6. The total personal and commercial residential insured losses provided in Forms A-2 and A-3 will be reviewed individually for total personal residential and total commercial residential insured losses.
7. Forms A-4 and A-5 will be reviewed, including geographical representations of the data when applicable.
8. Justify all changes in loss costs from the previously accepted submission.
9. Form A-4 will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.
10. Anomalies in the output range data will be reviewed and shall be justified.

Pre-Visit Letter

33. Provide detailed results for Monroe County at the ZIP Code level for all Actuarial forms.
- 35.A-6.F, page 119: Describe how the quality of building code enforcement is implicitly addressed.

36. Form A-1: Explain the number of ZIP Codes used in completing this form (exceeds the number of ZIP Codes in Florida).
37. Form A-4: Explain the relative values of Frame Renters versus Frame Owners, especially for the Low category.
38. Form A-4, pages 241 & 247: Explain "high" loss costs that are greater for masonry than frame (e.g., Alachua and Broward Counties).
39. Form A-5, page 262: Explain the apparent anomaly for Jackson County.
40. Form A-5, pages 256-263: Explain the variations in the western panhandle.
41. Form A-6, page 264: Describe the process and provide the documentation for all steps to complete Form A-6. Describe the steps taken to ensure sensibility of the results.
42. Form A-7, pages 266-275: Describe the process and provide the documentation for all steps to complete Form A-7. Describe the steps taken to ensure sensibility of the results.
43. Form A-7, page 270: Explain the results for Commercial Residential (e.g., Coverage A versus Coverage C for inland; -2.7% Coverage D for coastal versus 0% elsewhere).

Verified: NO YES

Professional Team Comments:

RMS notified the Professional Team of an error in the submitted Forms A-4, A-5, and A-7. The forms were not completed using the final corrected annual deductible ratio table. An error in the reverse geocoding methodology for assigning the appropriate vulnerability or inventory regions incorrectly assigned ZIP Codes to user defined latitude/longitude coordinates. This also affected Form A-7.

Reviewed loss costs results for Monroe County in Forms A-1, A-2, and A-3, and in corrected Forms A-4 and A-5.

Discussed the quality of building code enforcement is implicitly addressed by RMS in their different vulnerability regions.

Discussed Form A-1 ZIP Codes include all the ZIP Codes in RiskLink version 13.0.

Discussed the building attributes in Form A-4 were the cause of the overall risk lower for owners frame than renters frame.

Discussed results in Form A-4 for Alachua and Manatee counties.

Discussed the process used to complete Form A-6

Reviewed revised Form A-1 and Form A-5 maps with the minimum and maximum values and locations plotted.

Discussed use of historical storms loss costs to evaluate model skill. Discussed relevance of storm parameter choice in these reconstructions.

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

Reviewed revised Form A-7 after the Geocoding Update where two grid points assignments were changed.

Reviewed Form A-7 delta spreadsheet giving the difference in the percentage differences between the revised Form A-7 and the Form A-7 submitted on March 11, 2013.

Reviewed revised Forms A-4 and A-5 completed using the final corrected annual deductible ratio table and the 2012 Geocoding update that resolved the reverse geocoding issue.

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, S-2, and S-3 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

45. Form S-2, page 281: Explain how a majority of the years have no landfalling hurricanes in Florida yet the median losses are non-zero.

Verified: YES

Professional Team Comments:

Discussed losses in Florida may come from landfalling storms, by-passing storms, and storms approaching Florida.

Reviewed in the context of other standards, goodness-of-fit of distributions to historical data.

Discussed the explanation for non-zero median losses.

Additional Verification Review Comments

Reviewed revised Form S-2 incorporating the new Return Period Loss Annual Deductible Factors included for the FHCF exposure data, the two new ZIP Codes from the 2012 Geocoding update, the Annual Deductible Factors applied to the average annual loss for the FHCF exposure data, and corrected to update the median and interquartile numbers not originally updated from the previous submission.

Reviewed equation to convert Return Period Losses from occurrence deductible gross Return Period Losses to annual deductible Return Period Losses.

Reviewed equation for standard deviation adjustments to show the impact of annual deductibles.

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 will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Verified no changes from the previous submission and no new sensitivity tests were required or performed.

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 will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Verified no changes 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.

Pre-Visit Letter

- 44.S-4, page 137: Demonstrate specifically that the error in the sampling process is negligible. Present the 4 steps described in Disclosure 1 in detail with an illustrative example.

Verified: YES

Professional Team Comments:

Discussed the 4-step process for calibrating a reduced storm set in RiskLink version 13.0.

Reviewed county level calculations demonstrating that the standard errors are less than 2.5% of the average loss costs for each county.

S-5 Replication of Known Hurricane Losses*

(*Significant Revision)

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

Verified: YES

Professional Team Comments:

Reviewed results provided in Form S-4 and determined that the submission results were reasonable in light of model updates.

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 will be reviewed for consistency with Standard G-1, Disclosure 5.
2. Justify the following:
 - a. Meteorological parameters,
 - b. The effect of by-passing hurricanes,
 - c. The effect of actual hurricanes that had two landfalls impacting Florida,
 - d. The departures, if any, from the windfield, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration,
 - e. Exposure assumptions.

Verified: YES

Professional Team Comments:

Reviewed Form S-5 for consistency with overall submission and determined that the submission results were reasonable in light of model updates.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation*

(*Significant Revision)

- 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 binder, 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 binder, in either electronic or physical form, and its maintenance process will be reviewed. The binder 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.C that contain the items listed in Standard G-1, 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, C-3, C-4, C-5, and C-6.

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

Pre-Visit Letter

46.C-1.B, page 143: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 (page 36) by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Reviewed the table required in Standard C-1.D and a subsequent revision of the table during the audit, and verified that the item numbers on the left side of the table corresponded with the changes to the model captured in response to Standard G-1, Disclosure 5.

Reviewed RMS Geocoding 2012 Online Library documentation.

Discussed documentation maintained in TFS and SharePoint.

Discussed source code maintained in TFS and SVN.

Reviewed the geocoding users guide.

Reviewed documentation for completion of actuarial forms.

Additional Verification Review Comments

Reviewed documentation for the new Return Period Loss Annual Deductible factors.

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

47.C-2, page 144: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5 (page 36).

Verified: YES

Professional Team Comments:

Discussed the process and timing for creating requirements documentation. Reviewed revised requirements to ensure that requirements occur before changes to the model.

Discussed the procedure where the modeling team produces requirements for the development team responsible for the computer code implementation.

Reviewed requirements documentation for each model change.

Reviewed incident reports associated with modeler diagnostics that led to changes in the model. These reports were indexed in a column of the table required by Standard C-1.D, and included documentation for (1) model changes from the previously accepted model submission, and (2) model changes since the November 2012 submission.

C-3 Model Architecture and Component Design

The modeling organization 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:

Revised the flowchart defining the process for updating ZIP Codes.

Verified no change in the ZIP Code updating procedures since the previously accepted submission.

Reviewed the annual deductible ratio creation process flowchart.

Reviewed the data flow diagram used to create Form A-6. This diagram included a visual annotation indicating the location of the annual deductible ratio calculation error.

Reviewed the technical flowchart approach to computing the aggregate AAL, occurrence AAL, and the function that produces the annual deductible factors for the model.

Reviewed flowcharts for completion of vulnerability forms.

Reviewed actuarial form generation flowchart.

Reviewed annual deductible ratio creation process data flow diagram.

Reviewed the data flow diagram and the SQL script for creating Form A-6.

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, 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 pending verification of Standards A-1 and A-6.

Reviewed the table of software components required by Standard C-4.D.

Reviewed the data flow diagram and the SQL script for creating Form A-6.

Reviewed occurrence and annual deductible calculations in the source code.

Reviewed the modeler's use of a point-in-polygon algorithm in third-party software rather than a nearest-intersection algorithm, since the latter approach resulted in errors for some reverse geocoding functions.

Reviewed equations used for application of the annual deductible factors.

Reviewed the methods used to trace from flow diagrams to the code level.

Reviewed script that contained the logic for the annual deductible calculation.

Ensured a trace-through functionality connecting annual deductible flowchart components to script components.

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

Verified after resolution of outstanding issues with Standards A-1 and A-6.

Reviewed the data implementations for 1) return period loss (RPL) for annual deductible factors, 2) geocoding update, and 3) Form S-2 update.

Reviewed the implementation of equations associated with return period loss.

Reviewed the table required by Standard C-4.F for the return period loss equations.

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. Crosschecking procedures and results for verifying equations 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.

Pre-Visit Letter

48.C-5, pages 151-154: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5 (page 36).

Verified: NO YES

Professional Team Comments:

This standard cannot be verified pending verification of Standards A-1 and A-6.

Reviewed the modeler's approach to calculating annual deductible factors given the error presented by the modeler in their October 30, 2012 letter to the Commission. Reviewed (1) the documented history of discovering this error, (2) the location in the program flow identifying the issue, and (3) the modeler's revised quality assurance methods for mitigating similar errors in the future.

Reviewed the checklist verification procedures for insurance data used in the modeling process.

Reviewed QA process documentation on creating submission forms, "Creation of Actuarial Forms for the FCHLPM submission." Discussed application of the test to verify that the correct annual deductible table is used in form generation.

Discussed with the modeler the quality assurance processes used when data are obtained from insurance companies. Quality assurance procedures rely on communication between the modeler and the insurance companies providing the data.

Reviewed the revised test plan for completion of the 2012 actuarial forms, "Test Plan for 2012 FCHLPM Actuarial Forms."

Reviewed test plan for the geospatial update in version 13, "QA Test Plan Geospatial Testing for R13 Update." Discussed various tests completed:

- Task 8, R13 Table Consistency Testing
- Task 9, Regeocoding Analysis
- Vintage Update Testing

Reviewed test methodology to complete a point-in-polygon look-up with the complete set of grid points to identify the ZIP Code in which each grid point lies and comparison to the ZIP Code from the RiskLink geocoding process.

Reviewed reverse geocoding test case.

Reviewed revision of reverse geocoding methodology documentation “Geostan Update Patch, incident 32390” and “Geostan Update Patch, incident 32385” including the results from the testing program.

Reviewed the test methodology for Form A-4 to verify the annual deductible ratios used to generate the results are the final version of the annual deductible ratios.

Reviewed the test methodology for Forms A-6 and A-7 to verify that the annual deductible ratios used to generate the results in Sets 1 and 2 are the final version of the annual deductible ratios.

Discussed the use of test plans for third party vendor data.

Reviewed checklist for importing insurance claims data and a client claims data summary.

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

Verified after resolution of outstanding issues with Standards A-1 and A-6.

Reviewed verification approaches used to observe near-zero percent changes in loss cost for logical relation to risk.

C-6 Model Maintenance and 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 shall result in a new model version number.***
- C. The modeling organization shall use tracking software to identify 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 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.
4. The list of all model revisions as specified in C-6.D will be reviewed.

Pre-Visit Letter

49.C-6.D, page 156: 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 history of model revisions over the previous 5 years as required by the pre-visit letter.

Verified that the modeler uses tracking software for code, data, and documentation.

Discussed the modeler's logic for creating model revisions, specifically for the modeler's choice of transitioning from RiskLink version 11.0.SP2 to RiskLink version 13.0.

Reviewed a revised model update policy to reflect decision to make updates to the model is not necessarily annual and that the major number directly corresponds to year of release.

Discussed with the modeler that since the annual deductible factor table is considered to be an integral part of the model, and since this table was found to be in error (reference October 30, 2012 letter to the Commission from RMS) that a new model version would need to be created and announced to the modeler's clients.

Reviewed the modeler's plan to produce a new model version to replace the previously accepted submission, RiskLink 11.0.SP2. The new model version is identified as RiskLink 11.0.SP2c.

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

Discussed with the modeler a requirement to change the model revision number based on changes to the output ranges. The modeler revised their documentation to update the model version number by an updated software build number.

Reviewed the model version policy and numbering systems. Discussed use of build numbers to identify a particular iteration of the model infrastructure and data during a release development cycle. The model version number is to be updated to reflect the model reviewed by the Professional Team, RiskLink 13.0 (Build 1509).

Reviewed interim builds and discussed that these builds were unrelated to hurricane winds for Florida.

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 no breaches in security or changes in the security approaches used by the modeler.

Reviewed updates to the process for training new employees on data back-up and restore processes and security for information stored on networks, servers, shared drives, and other shared resources.

Reviewed the new one page addition to the training for new modeler personnel ("new hires") on the importance of choosing passwords that are unlikely to be easily cracked.

Verified that the modeler uses an automated approach to ensure stronger passwords by insisting on a combination of different types of characters and a password of at least 8 characters in length.