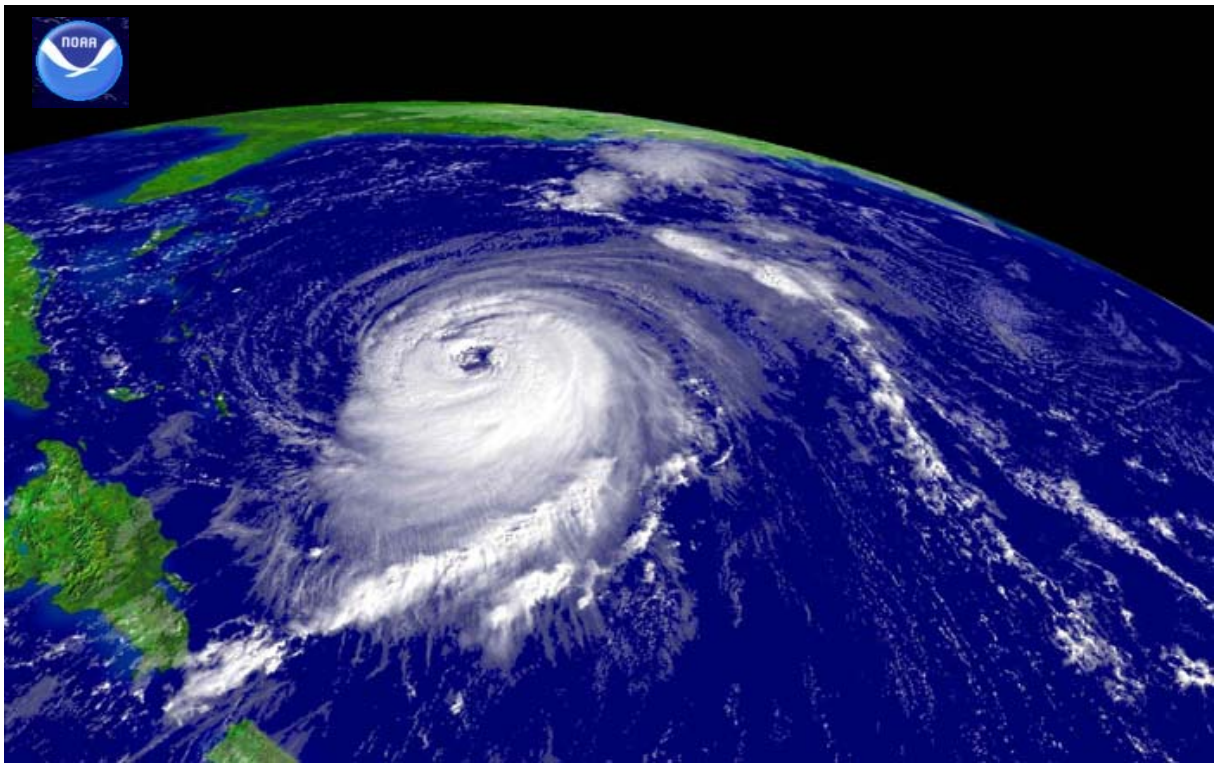
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2003 Standards

Risk Management Solutions, Inc.

On-Site Review
April 26 – 28, 2004

On April 26-28, 2004, the Professional Team visited on-site at Risk Management Solutions, Inc. (RMS) in Newark, California. The following people participated in the review.

RMS

Richard R. Anderson, FCAS, MAAA, Chief Actuary
Kyle A. Beatty, Manager Technical Marketing and Catastrophe Response
Auguste Boissonnade, Ph.D., Vice President and Principal Scientist
Michael Drayton, Ph.D. - consultant
Guy C. Morrow, S.E., Vice President Model Development
Mohsen Rahnama, Ph.D., Vice President – Engineering & Model Development
John Reiter, Vice President, RiskLink Software Development, Catastrophe Applications, RiskLink Product Development
Mohan P. Sharma, Ph.D., Principal Engineer
Pane Stojanovski, Ph.D., Vice President, Model Development Operations
Jim Tomcik, Vice President, Quality Assurance
Michael Young, M.E.Sc., P.E., Lead Wind Vulnerability Engineer

Professional Team

Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Fred Stolaski, P.E., Structural Engineer
Nur Yazdani, Ph.D., P.E., Structural Engineer observer
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process. RMS gave a presentation highlighting the hurricane risk model components and outlining the model changes since the February 2003 submission and the associated effects on loss costs. Some of this presentation will be given to the Commission in May. Changes to the model components since the previous submission are:

- Renormalization of hurricane event rates
- Update of ZIP Code data vintage
- Correction, revision, and expansion to mitigation measure options used to scale the vulnerability functions

RMS provided a detailed explanation of the changes in RiskLink 4.32a to the secondary modifiers. The Professional Team reviewed examples of updates to existing modifiers, new modifiers that were added, and revisions made to modifiers due to keying or implementation errors, reviewed new options to existing modifiers include roof geometry, roof covering, roof anchor, wind resistance windows, and architectural elements (skylights with and without cover), discussed in detail how the secondary modifiers were changed, the underlying reasons for the changes, and the impact of the revisions or the potential change by county to the AAL in Florida, and discussed and reviewed corrections to be made to the submission that will be provided to the Commission prior to the May 12 & 13, 2004 meetings.

- Page 70, Figure 6 corrected to include official storm set and historical storms in neighboring states

RMS submitted a letter to the Chair, FCHLPM on April 6, 2004 regarding clarification and compilation of errors previously noted. In conjunction with the Professional Team on-site visit April 26-28, 2004 these errors and RMS' handling of them were scrutinized. In particular, the Professional Team did the following:

Instance 1, August 2003.
As described in the April 6, 2004 summary, the errors had no bearing on the materials leading to the acceptance by the Commission of RiskLink 4.3a. We reviewed correspondence between RMS and their clients. The analysis of the Instance 1 error led to a revised and expanded QA process for detecting similar errors. Instance 1 error involved an error in the macro used to modify the wind bands from RiskLink 4.2.

Instance 2, March 23, 2004.
The errors noted for this instance do impact materials in support of Commission acceptance of RiskLink 4.3a. The Instance 2 errors were discovered through their newly implemented QA procedures. As stated in the April 6, 2004 summary, results (mitigation measure impacts) on concrete/clay tiles were incorrectly reported (although the baseline material remains verified). RMS recommended to their clients that RiskLink 4.3a not be used with the incorrect roof covering modifier for personal residential property insurance rate filings in the state of Florida. According to RMS, this error impacted no rate filings made in the state of Florida for personal residential property insurance. If RMS determines through subsequent activity that any Florida personal residential property insurance rate filings were impacted, RMS will inform the Commission immediately.

Instance 2 involved two classes of errors, the first was roof coverings and in particular, concrete/clay tiles. The second class involved roof age which is not considered in producing material for the Commission. The problematic macro was reviewed and we concur with the RMS assessment. RMS informed the Professional Team that they have contacted each of their clients, and determined that the mitigation factors that were in error have not been used in support of personal residential property insurance rate filings involving RiskLink 4.3a in the state of Florida. If RMS determines through subsequent activity that any Florida personal residential property insurance rate filings were impacted, RMS will inform the Commission immediately. We also reviewed the revised macro and the associated Quality Assurance procedures.

The Output Ranges (which involve unmitigated structures) are not impacted in RiskLink 4.3a or RiskLink 4.32a.

Exhibit 2 of the April 6, 2004 letter and the associated materials were reviewed in detail during the on-site visit.

Deficiencies from March 18, 2004 Meeting

1. G-2.2.D (page 50) – incomplete response (indicate specifically whether the individuals are associated with the insurance industry, consumer advocacy group, or a government entity as well as their consulting activities).

Verified: YES

2. M-2.6 (page 69/70) – Figure 6 incomplete (gates 28, 29, and 30).

Verified: YES

3. M-5.3 (page 79) – collection and publication dates of land use and land cover data not provided.

Verified: YES

Risk Management Solutions, Inc. – 2003 Pre-Visit Letter

The main purpose of the on-site review performed by the Professional Team (Pro Team) of the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) is to verify that the written and electronic submission conforms to the model producing the output ranges included in the submission to the FCHLPM. It is particularly important to review in detail all information relating to the model, including any information that may be considered proprietary. Be prepared to respond to questions and requests for material as outlined in the Audit section under each Standard. It is the responsibility of the modeler to provide all information necessary for a complete review of the model.

For each reference within the submission that cites "material will be shown to the professional team," it is important that the material is presented to the Pro Team during the on-site review. Material that the modeler intends to present to the FCHLPM should also be presented to the Pro Team during the on-site review.

All aspects of the computer software will be reviewed including software either developed off-site or contracted out. Spot checks will occur during the review process, and all relevant personnel for the software being reviewed will need to be present when called upon. If software component authors are not present during the on-site review, the modeler shall have proxies for those components.

In the course of preparing for the on-site review, the Pro Team has identified some specific areas and questions that it intends to cover while on-site. These items are provided below to assist the modeler in preparing for the on-site review. Some of this material may have been shown or available on a previous visit by the Pro Team. The Pro Team will also be considering material in response to the Commission's designation(s) of omissions or responses deemed non-responsive.

The goal of the Pro Team is to provide the FCHLPM with a clear and thorough report of the model, subject to non-disclosure conditions. All modifications, adjustments, assumptions, or other criteria that were included in producing the information requested by the FCHLPM 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 Pro Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Pro Team. The Pro Team should be provided access to a phone line that can provide internet access through one of the Pro Team member computers for reference work that may be required while on-site.

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

General Standards

1. **G1.2** (page 14) – Be prepared to present the studies referenced in this response along with the investigation that resulted in a more accurate definition of storm characteristics at landfall.
2. **G1.2** (page 18) – Be prepared to discuss storm intensity as described in being linked to sea surface temperature (SST) and to provide equations and references. Be prepared to discuss in detail:
   - The SST input data file used. What is its temporal component (e.g., climatological or individual years)? What is its spatial resolution?
   - Is there a stochastic component to the actual storm intensity? To what extent, if any, is the concept of an SST-dependent *potential intensity* (*PI,* was formalized by Emanuel, 1986) extended to comprise more than a theoretical upper bound of possible intensities under favorable environmental conditions.
   - Extent to which historical storms have reached their PI.
   - How does storm intensity shift to match the SST when a storm re-emerges over water (after making landfall)? Is there a relaxation time? If so, how is this determined or assigned?
   - PI is also sensitive to the choice of the storm center relative humidity (RH, often taken to be 100%), the environmental RH and the environmental surface pressure. How are each of these variables assigned for each simulated storm?
3. **G1.2** (page 19) – Define ΔP, central pressure difference and be prepared to describe the method of derivation.
4. **G1.2** (page 19) – Be prepared to discuss how parameters a, b, and c are region dependent.
5. **G1.3** (page 24-25), Figure 4 – Be prepared to discuss if the historical storm database includes bypassing storms.
6. **G2.2.B** (page 48) – Provide resumes for new employees working on the model.
7. **G2.2.C** (page 49) – Provide names for personnel involved in Figure 5.
8. **G3.A** (page 54) – Be prepared to provide more details on the third party ZIP Code supplier.
9. **G3.B** (page 54) – Be prepared to discuss in more detail the response provided.

Meteorological Standards

10. **M2.3** (page 68) – Be prepared to discuss the response provided and to give a detailed description of the development of the upstream surface friction effects and how this translates to conversion of 10-minute winds to peak gusts.
11. **M2.6** (page 70) – Be prepared to discuss Figure 6 in more detail.
12. **M4.1** (page 75) – Provide the sea surface temperature data analyzed by Professor Emmanuel Kerry.
13. **M4.1** (page 75) – Be prepared to provide more details on H*WIND from AOML and how this is used.
14. **M4.3** (page 76) – Provide clarification for statistics given in Figure 7.

15. **M5.A** (page 77) – Be prepared to elaborate in more detail "on the methodology and specific scientific references used to develop the model's land friction coefficients."
16. **M5.A** (page 78) – Provide horizontal scale for Figure 8.
17. **M5.3** (page 79) – Be prepared to elaborate on response provided. How does resolution of NLCD blend with resolution of wind field model?
18. **M5.4** (page 80), Figure 9 – Be prepared to show what happens after 24 hours.
19. **M5.4** (page 80) – Be prepared to describe and discuss relationship differences between "stochastic" and Kaplan-DeMaria weakening rates through time. Provide graphical representation of modeled storms in this format.
20. **Form M-2** (page 85) – Be prepared to explain apparent density discontinuities as 920 and 940 mb.

Vulnerability Standards

21. **V1.E** (page 88) – Be prepared to discuss the use and range of "Year Modifiers" for changes in building codes and building construction practices.
22. **V1.2** (page 92) – Provide x-axis labels for Figure 14.
23. **V2.1** (page 97) – Be prepared to discuss why the submission states that condo unit owners have separate vulnerability functions, but the percent change in damage due to the individual mitigation measures is exactly the same as for Owners.
24. **Form V-1** (page 103) – Be prepared to discuss use of increased wind speeds and addition of mitigated frame and masonry structure. For future submissions we anticipate a revision to Form V-1 with higher wind speeds and the addition of mitigated frame and masonry structure. Do you have any comments?
25. **Form V-1** (page 103) – Be prepared with documentation to justify statement on Base Mobile Home structure in comparison to Base Frame structure.
26. **Form V-2** (page 105) – Results of the runs at the various wind speeds for individual mitigation measures should be available and selected examples will be reviewed. Be prepared to discuss changes in instructions such as choice of required ZIP Codes, range of wind speed, list of required mitigation measures, use of "Renters' and "Condo Unit Owners" sections, weighted average, change in damage at specific wind speeds rather than a range, adding structures with specific combinations of mitigation measures, etc.

Actuarial Standards

27. **A1.A** (page 107) – Provide any insurance data obtained since the prior review of your model by the FCHLPM.
28. **A1.7** (page 109) – Be prepared to describe how loss adjustment expenses are excluded within the loss cost estimates.
29. **A2.2** (page 110) – Provide verification that demand surge is turned off for FCHLPM output ranges, loss costs, etc.

30. **A3.4** (page 113) – Provide detailed descriptions of the validation tests referenced in the response.
31. **A4.3** (page 117) – Be prepared to discuss plots in Figure 16. Are they consistent with Form V-1?
32. **A6.2** (page 121-122) - Provide axes labels for Figure 17. Provide the complete set of "claims data used by RMS to develop the contents damage curves."
33. **Form A-1** (page 127) – Be prepared to discuss the large decrease in losses compared with previous year submission.

Statistical Standards

34. **S1.5** (page 135) – Be prepared to discuss empirical curves outside the bands.
35. **S2.3** (page 138) – Be prepared to discuss Figure 22 and choice of earlier version of Form F for illustration.
36. **S2.5** (page 139) – Be prepared to provide the details of this response. How does the variation vary with central pressure and latitude?
37. **S5** (page 146), Figure 25 – Provide explanation for two Andrew and Hugo sets of bars.
38. **S5.2** (page 148-149), Figure 26 and Figure 27 – Provide interpretation of these figures. Be prepared to explain the decreasing trend in Figure 27.
39. **S6.1** (page 150) – Provide your definition of "an acceptable range."
40. **S6.3** (page 151) – Be prepared to explain the increase from the previous year.
41. **Form S-1B** (page 249-262) – Be prepared to discuss zero values for weighted averages.

Computer Standards

42. **C1.A** (page 293) – Provide the primary document binder for review.
43. **C2.1** (page 293-294) – Provide requirements documentation for review.
44. **C4** (page 297) – Provide detailed data flow diagrams of the model components for review.
45. **C7** (page 303) – Provide referenced systems and procedures for review.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation

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

Audit

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

Verified: YES

Professional Team Comments:

Discussed Charles J. Neumann's involvement in the development and review of the historical storm database and the use of HURDAT.

Discussed the relationship between storm intensities and sea surface temperature.

Reviewed minimum central pressures by grid cell of historical versus modeled input. Discussed differences in minimum pressures of modeled Florida landfalling storms from historical storms.

Discussed how the model handles re-intensification of storms over water.

Discussed the method of derivation of the central pressure difference utilized in the wind field model.

Discussed the inclusion of bypassing storms in the historical storm database.

G-2 Qualifications of Modeler Personnel and Independent Experts

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

B. The model or any modifications to an accepted model shall be reviewed by modeler personnel or independent experts in the following professional disciplines, if relevant: structural/wind engineering (licensed Professional Engineer (PE)), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall abide by the standards of professional conduct if adopted by their profession.

Audit

The Professional Team will review the professional vitae of modeler personnel and independent experts responsible for the current model and information on their predecessors, if different than current personnel. Background information on individuals providing testimonial letters in the submission shall be provided.

The Professional Team will review Form G-1 and all independent peer reviews of the model.

Discuss any incidents where model personnel have failed to abide by the standards of professional conduct adopted by their profession.

Verified: YES

Professional Team Comments:

Reviewed resumes of modeler personnel new to RMS or to work in RMS with RiskLink 4.32a:

- Kyle A. Beatty, M.S., Meteorology, University of Oklahoma
- Jayanta Sinha, B. Tech Civil Engineering, Govind Ballabh Plant University, Pantnagar, India
- Michael Young, P.E., Masters in Engineering Science, University of Western Ontario

Reviewed personnel involved with each aspect of the model as outlined in Figure 5 on page 49. Discussed modeler roles that changed in the past year.

Discussed RMS' presentation of the changes in the U.S. Hurricane model last year to Standard and Poor's, Moody's, A.M. Best, and Fitch.

G-3 Risk Location

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

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

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

Audit

Provide geographic displays for selected ZIP Codes. The Professional Team will review the location of specific centroids.

Verified: YES

Professional Team Comments:

Discussed the third party ZIP Code supplier and the process used in updating the ZIP code database.

Reviewed RMS' use of a variable resolution grid for calculating exposure, wind speeds, and loss by cell.

Selected five ZIP Codes affected by Hurricane Andrew (33122, 33158, 33170, 33179, 33180) and reviewed the modeled maximum wind speeds, the modeled exposures, and the modeled losses.

Reviewed maps of population weighted ZIP Code centroids for Florida and Santa Rosa and Osceola counties showing the effect of centroid updates on loss costs.

G-4 Units of Measurement

A. All units of measurement for model inputs and outputs shall be clearly identified.

B. All model outputs of length, wind speed, and pressure shall be in units of statute miles, statute miles per hour, and millibars, respectively.

C. Wind inputs to the damage function shall be in units consistent with currently used wind measurement units and/or shall be converted using standard meteorological/engineering conversion factors.

Audit

The Professional Team will review the model to assess the appropriateness and accuracy of the measurements, conversion factors, and techniques.

Verified: YES

Professional Team Comments:

Appropriate units of measurement were verified throughout the review process.

G-5 Independence of Model Components

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

Audit

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

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

Verified: YES

Professional Team Comments:

The independence of the meteorology, vulnerability, and actuarial components were verified throughout the course of the review. There was no evidence discovered to imply dependence.

METEOROLOGICAL STANDARDS – Jenni Evans, Leader

M-1 Official Hurricane Set*

*(*Significant Revision)*

For landfall frequency analyses, the modeler shall use the latest updated Official Storm Set. Updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to the storm set.

Audit

The modeler will provide the storm set used. Failure to update the storm set, as specified in the Standard, is not acceptable.

Verified: YES

Professional Team Comments:

Verified that the historical storm set had been updated through 2002.

Verified that the stochastic storm set reflected this change.

M-2 Hurricane Characteristics*

*(*Significant Revision)*

Methods for depicting all modeled hurricane characteristics, including but not limited to wind speed, radial distributions of wind and pressure, minimum central pressure, radius of maximum winds, strike probabilities, tracks, and the time variant wind fields, shall be based on information documented by currently accepted scientific literature or modeler information accepted by the Commission.

Audit

Prepare graphical depictions (e.g., histograms overlaid with fitted density functions) of storm characteristics as used in the model. Describe:

- the data set basis for the fitted distributions,
- the assessments of correlated characteristics (e.g., central pressure and radius of maximum winds),
- the fitting methods used and any smoothing techniques employed, and defend the choices of distributions used,
- the spatial distribution of hurricane force winds associated with both modeled and historical events.

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

The modeler will present time-based contour animations (capable of being paused) of wind and pressure fields to demonstrate scientifically reasonable wind field characteristics.

The Professional Team will compare the treatment of uncertainties associated with the conversion of gradient winds to surface winds with currently accepted literature.

Map the location of the peak hurricane intensity compared to the western most point of a random selection of recurving storm tracks for hurricanes effecting Florida.

Verified: YES

Professional Team Comments:

Reviewed CDF test plots comparing historical to modeled storm characteristics of central pressure, filling rate, and forward velocity.

Reviewed animated wind speed and pressure contour plots for a Category 3 storm verifying the asymmetric nature of hurricanes as well as other wind field characteristics in the model.

Discussed the methodology for using gradient winds to derive the 10-minute over-water wind speed and the conversion to 3-second peak gusts.

Reviewed mapping of historical tracks of time from western-most point to point of minimum pressure and comparisons of historical versus stochastic distribution of times and locations.

Discussed the methodology for modeling Rmax and reviewed plots of Rmax versus central pressure for modeled storms.

Discussed how the asymmetric nature of hurricanes is considered in the model.

Reviewed color-coded map of Hurricane Andrew peak gust winds on a variable resolution grid.

Discussed relationship between speed of motion and future heading.

Discussed the relationship between storm intensities and sea surface temperature.

Discussed the use of the H*WIND analysis data set from Atmospheric, Oceanic and Marine Laboratory (AOML).

A corrected Figure 6, page 70 to be provided to the Commission.

Revised documentation received by the Commission.

M-3 Landfall Intensity

Models shall use maximum one-minute sustained 10-meter wind speed when defining hurricane landfall intensity. This applies both to the Official Storm Set used to develop landfall strike probabilities as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter wind speed shall be within the range of wind speeds (in statute miles per hour) categorized by the Saffir-Simpson scale.

Saffir-Simpson Hurricane Scale (for displayed parameters):

Category	Winds (mph)	Central Pressure (mb)	Damage
1	74 - 95	$\geq$ 980	Minimal
2	96 - 110	965 - 979	Moderate
3	111 - 130	945 - 964	Extensive
4	131 - 155	920 - 944	Extreme
5	Over 155	< 920	Catastrophic

Audit

Demonstrate the goodness-of-fit of the frequency distributions of category 3-5 hurricanes.

Demonstrate that the hurricane intensity at landfall is consistent with the Saffir-Simpson wind range for the stochastic storm set.

Verified: YES

Professional Team Comments:

Discussed how RMS defines a model event. Historical storms that "hit" Florida are historical storms that cause "losses" in Florida and therefore include landfalling and bypassing storms.

Discussed RMS procedure for modeling intensity at landfall. Verified that landfall intensity is defined by one-minute mean surface wind.

M-4 Hurricane Probabilities

A. Modeled probability distributions for hurricane intensity, eye diameter, forward speed, radii for maximum winds, and radii for hurricane force winds shall be consistent with historical hurricanes in the Atlantic basin.

B. Modeled hurricane probabilities shall reasonably reflect the historical record through 2002 for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).

Audit

Probabilities are compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The Professional Team will review the goodness-of-fit of modeled to historical hurricane frequencies for the four regions of Florida and overall as provided in Form M-1.

Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.
Describe and support the method of selecting stochastic storm tracks and angles of landfall.

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.

Demonstrate the goodness-of-fit of parametric distributions to historical hurricane characteristics.

Verified: YES

Professional Team Comments:

Reviewed tests of a Poisson distribution and Poisson CDF of landfall rates for the entire state of Florida and by region. Reviewed the goodness-of-fit for neighboring states, Georgia, Alabama, and Mississippi.

Reviewed correlations between modeled Rmax to reported observations.

Reviewed choice of coastal intervals used to verify landfall frequency.

Reviewed choice of model storm genesis locations.

M-5 Land Friction and Weakening*

A. *The magnitude of land friction coefficients shall be consistent with currently accepted scientific literature, consistent with geographic surface roughness, and implemented with appropriate geographic information system data.
*(*Significant Revision)*

B. The hurricane overland weakening rate methodology used by the model shall be reasonable in comparison to historical records.

Audit

Justify the collection and publication dates of the land use and land cover data used in the model.

Maps depicting land friction effects are required. Describe the representation of land friction effects in the model.

Comparisons of the model's weakening rates to historical Florida storms and to weakening rates will be reviewed.

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

Verified: YES

Professional Team Comments:

Discussed the land use and land cover data used in the model, its source, and the processing of the information undertaken by RMS.

Discussed the development of the surface roughness database and its sampling, and the model's land friction coefficients. Reviewed plots showing the degradation of winds in relation to the distance from the coast.

Discussed in detail RMS' model decay rates and the underlying methodology. Reviewed graphical representation of filling rates of historical storms staying over land in Florida.

Discussed treatment of model storm intensity when a landfalling storm re-emerges over water.

M-6 Logical Relationships of Hurricane Characteristics

A. The radius of maximum winds shall reflect historical hurricane characteristics.

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

C. The wind speed shall decrease with increasing surface roughness (friction), all other factors held constant.

Audit

Forms M-2, M-3, and the modeler's sensitivity analyses provide the information used in auditing this Standard.

Verified: YES

Professional Team Comments:

Discussed the results provided in Form M-2 and Figure 10.

Reviewed code for gradient wind development, including asymmetry due to motion.

Reviewed code for storm intensity simulation over water.

Reviewed code for landfalling storm intensity.

Reviewed procedure for verifying model landfall rates.

Reviewed Figures 11 and 12 (Form M-3) comparing modeled historical and stochastic one-minute winds over Florida.

VULNERABILITY STANDARDS – Fred Stolaski, Leader

V-1 Derivation of Vulnerability Functions*

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

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

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

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

E. In the derivation and application of vulnerability functions, assumptions concerning building code revisions and building code enforcement shall be reasonable and be theoretically sound.
*(*Significant Revision)*

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

G. The minimum wind speed that generates damage shall be reasonable.

Audit

Historical data should be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. To the extent that historical data are used to develop vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete structural calculations shall be presented so that a variety of different building types and construction characteristics may be selected for review. The basis for expert opinion and original site inspection reports should be available for review.

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

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

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

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

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

Describe how the duration of wind speeds at a particular location over the life of a hurricane is considered.

Form V-1 will be reviewed.

Verified: YES

Professional Team Comments:

Verified there were no changes made to the model's vulnerability functions. No new insurance company data, site inspections, or references.

Reviewed goodness-of-fit tests of modeled data versus historical data and discussed how the results were considered in the development of the vulnerability curves.

Discussed the process for reviewing data collected from the various insurance clients. Reviewed loss data by Line of Business, Construction Class, Type of Coverage and Exposure included in Loss Data, Binder #1.

Reviewed several vulnerability curves of the mean damage ratio versus peak gust wind speed for masonry, wood frame, and mobile homes.

Verified in the computer code that damage does not start accumulating until the peak gust wind speed reaches 50 mph.

Verified that duration of the storm is not considered in the derivation of the vulnerability functions.

Discussed how the Florida Building Code is handled in the model and the adjustments made to the vulnerability functions. Reviewed the modifiers for year of construction that scale the base vulnerability curves up or down.

Reviewed Form V-1 and discussed in detail the results provided in Part B where wood frame have higher losses than mobile home. Reviewed development of modification factors used to adjust vulnerability curves based on details of construction.

Review of Form V-1 included comparison and derivation of actual vulnerability curves to final percent change numbers shown in Form. Reviewed HAZUS curves that compared mobile home and weak wood frame and compared them to the RMS work.

Discussed refinements to Form V-1 format.

V-2 Mitigation Measures*

*(*Significant Revision due to Form V-2)*

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

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

B. Application of mitigation measures shall be reasonable both individually and in combination.

Audit

Form V-2 provides the information used in auditing this Standard.

Total effect on damage due to use of multiple mitigation measures will be reviewed and shown to be reasonable. Any variation in the change over the range of wind speeds for individual and multiple mitigation measures will be reviewed and shown to be reasonable.

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.

Verified: YES

Professional Team Comments:

Discussed in detail and reviewed calculations for applying secondary modifiers to the vulnerability curves by wind speed bands. Reviewed procedure used to increase number of wind speed bands.

Discussed the results provided in Form V-2 and reviewed graphs of the mean damage ratio versus one-minute sustained wind speeds for different structure types with and without mitigation features.

Discussed in detail and reviewed RMS' Test Plan for Secondary Modifiers, responsible parties, and testing that was completed prior to the February 28, 2004 submission.

Reviewed spreadsheets with raw data for Form V-2, including mapping of mitigation measures to model categories and description of base structure used. Also reviewed

computer runs at a higher wind speed resolution than required giving the required change in damage due to an individual mitigation measure.

Reviewed in depth the derivation of modification factors for all of the mitigation measures listed in Form V-2. Reviewed use of engineering calculations and expert opinion with emphasis that all items showed a logical and consistent relationship.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Underwriting Assumptions

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

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

Audit

Quality assurance procedures should include methods to assure accuracy of input insurance data prior to code execution. Compliance with this Standard will be readily demonstrated through rules and documented procedures.

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

Verified: YES

Professional Team Comments:

Verified no new insurance data has been obtained and reviewed actual loss data from insurance clients. Reviewed the procedures for processing insurance client data.

Reviewed procedures for dealing with anomalies in data.

Discussed model exclusion of Loss Adjustment Expense in loss cost derivations.

Discussed LAE footnote in submission. Discussed use of insurer data relative to claim practices.

A-2 Loss Cost Projections

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

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

C. Loss cost projections shall not explicitly include demand surge.

Audit

Demonstrate how the presence of demand surge has been considered in any analysis where Hurricane Andrew losses are used for development or verification of the model or its output. Demonstrate how demand surge is incorporated in any other data used in the development or verification of the model.

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

Verified: YES

Professional Team Comments:

Verified demand surge was not included in producing the loss costs. Discussed Hurricane Andrew claims data and adjustments made for demand surge when using Andrew and other major event data for validation.

A-3 User Inputs

All modifications, adjustments, assumptions, defaults, and treatments of missing values used in the model shall be actuarially sound and included with the model output.

Audit

All insurer inputs and assumptions will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the validation procedures for review and verification of insurer data and Zip Code data. Reviewed validation tests and assumptions on claims data sets contained in the Loss Data Binder.

A-4 Logical Relationship to Risk

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

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

C. Loss costs cannot increase as friction or roughness increase, all other factors held constant.

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 (A, B, C, D) shall be consistent with the coverages provided.

Audit

Graphic representations of loss costs by ZIP Code and county will be reviewed.
Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.
Individual loss cost relationships will be reviewed. Forms A-1 and A-2 will be used to assess coverage relationships.

Verified: YES

Professional Team Comments:

Reviewed Figure 16 plots in comparison to the results in Form V-1 for wood frame, masonry, and mobile homes, and verified their consistency.

Discussed the large decrease in losses provided in Form A-1 from the previous submission.

Discussed and reviewed individual coverage relationships.

A-5 Deductibles and Policy Limits

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

B. The relationship among the modeled deductible loss costs shall be reasonable. Differences in these relationships from those previously found acceptable shall be reasonable.

Audit

The modeler actuary may be asked to attest to the actuarial soundness of the procedure for handling deductibles and policy limits. To the extent that historical data are used to develop mathematical depictions of deductibles and policy limit functions, demonstrate the goodness-of-fit of the data to fitted models. Justify changes from the prior submission in the relativities among corresponding deductible amounts for the same coverage.

Verified: YES

Professional Team Comments:

Verified no change in the methodology for handling deductibles and policy limits.

A-6 Contents

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

B. The relationship between the modeled building and contents loss costs shall be reasonable, based on the relationship between historical building and contents losses. Differences in the relationship of building and contents loss costs from those previously found acceptable shall be reasonable.

Audit

The modeler actuary may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for contents coverage. 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. Justify changes from the prior submission in the relativities between loss costs for buildings and the corresponding loss costs for contents.

Verified: YES

Professional Team Comments:

Verified no changes were made to the methodology for handling contents losses.

Reviewed data provided in Figure 17.

Reviewed claims data used by RMS in the development of the contents damage curves.

A-7 Additional Living Expenses (ALE)

A. The methods used in the development of Additional Living Expense (ALE) loss costs shall be actuarially sound.

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

C. The relationship between the modeled building and ALE loss costs shall be reasonable, based on the relationship between historical building and ALE losses. Differences in the relationship of building and ALE loss costs from those previously found acceptable shall be reasonable.

Audit

The modeler actuary may be asked to attest to the actuarial soundness of the procedure for calculating loss costs for ALE coverage. Documentation and justification of the following will be reviewed:

A. The method of derivation and data on which the ALE vulnerability function is based;
B. Validation data specifically applicable to ALE;
C. Assumptions regarding the coding of ALE losses by insurers;
D. The effects of demand surge on ALE for Hurricane Andrew;
E. Assumptions regarding the variability of ALE by size of property;
F. Statewide application of ALE assumptions;
G. Assumptions regarding ALE for mobile homes, tenants, and condo unit owners exposure;
H. The methods used to incorporate the estimated time required to repair or replace the property;
I. The methodology and available validation for determining the extent of infrastructure damage and its effect on ALE costs.

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

Verified: YES

Professional Team Comments:

Verified no changes were made to the methodology for handling Additional Living Expense. Discussed the calculations used for determining ALE losses.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Use of Historical Data

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

B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods.

Audit

Graphical comparisons of modeled and historical data and goodness-of-fit tests will be reviewed. Examples include hurricane frequencies, tracks, intensities, and physical damage. Forms S-10 and S-11 will be reviewed.

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

Verified: YES

Professional Team Comments:

Discussed Figure 19 and the reason for the empirical curve outside the bands on the central pressure CDF test.

Reviewed results provided in Forms S-10 and S-11.

Reviewed wind speed tests comparing the average modeled wind speed to the average observed wind speed for Hurricanes Andrew and Hugo.

S-2 Sensitivity Analysis for Model Output

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

Audit

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

Form S-12 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Reviewed the results of a previous study reported on Form S-12 (previously Form F) and how RMS utilized the results of the study to re-analyze their approach to modeling Rmax.

S-3 Uncertainty Analysis for Model Output

The modeler shall have performed an uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods 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

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

Form S-12 will be reviewed for new modeling companies which have not previously provided the Commission with this analysis.

Verified: YES

Professional Team Comments:

Briefly reviewed previous study conducted on Form S-12 (previously Form F).

S-4 County Level Aggregation

At the county level of aggregation, the contribution to the error in loss costs estimates induced by the sampling process shall be negligible based upon currently accepted scientific and statistical methods.

Audit

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

Verified: YES

Professional Team Comments:

Discussed in detail the estimated impact on loss costs at the county level if the random number seed in the model development process were changed. Discussed use of Form S-11 to estimate sample sizes at the county level.

S-5 Replication of Known Hurricane Losses

The model shall reasonably replicate incurred losses on a sufficient body of past hurricane events, including the most current data available to the modeler. This Standard applies separately to personal residential and, to the extent data are available, to mobile homes. Personal residential experience may be used to replicate building-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail.

Audit

The following information for each insurer and hurricane will be reviewed:

1. 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,
2. The version of the model used to calculate modeled losses for each storm provided,
3. A general description of the data and its source,
4. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
5. The date of the exposures used for modeling and the date of the hurricane,
6. An explanation of differences in the actual and modeled storm parameters,
7. A listing of the departures, if any, in the wind field applied to a particular hurricane for the purpose of validation and the wind field used in the model under consideration,
8. The type of property used in each storm to address:
   a. Personal versus commercial
   b. Residential structures
   c. Mobile homes
   d. Condominiums
   e. Buildings only
   f. Contents only,
9. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.

The following documentation will be reviewed:

1. Publicly available documentation referenced in the submission,
2. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
3. An analysis that identifies and explains anomalies observed in the validation data,

4. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

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

Form S-6 will be reviewed.

Verified: YES

Professional Team Comments:

Discussed results shown in Figure 25 and in the residual plots in Figures 26 and 27 and reviewed the underlying data. Reasonable explanations for outlying points were provided.

S-6 Comparison of Estimated Hurricane Loss Costs

The difference, due to uncertainty, between historical and modeled annual average statewide loss costs shall be statistically reasonable.

Audit

Forms S-4, S-5, S-7, S-8, and S-9 will be reviewed.

Justify the following:

1. Meteorological parameters,
2. The effect of by-passing storms,
3. The effect of actual storms that have two landfalls impacting Florida,
4. The departures, if any, from the wind field, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration, and
5. Exposure assumptions.

Verified: YES

Professional Team Comments:

Discussed and reviewed the changes in the model that resulted in the change to the average annual statewide loss costs for simulated events.

S-7 Output Ranges

For a model previously found acceptable by the Commission, the differences in the updated output ranges shall be reasonable.

Audit

Forms S-1A, S-1B, S-2, and S-3 will be reviewed.

Justify the following:

1. Changes from the prior submission of greater than five percent in weighted average loss costs for any county.
2. Changes from the prior submission of five percent or less in weighted average loss costs for any county.

Verified: YES

Professional Team Comments:

Discussed the occurrences of 0.000 for the weighted average loss costs and verified the occurrences are due to the exposure weight file provided containing no exposure data for that policy form and construction within those counties.

Discussed the impact of the following model revisions on the statewide loss costs:

- Update of ZIP Code data vintage
- Renormalization of hurricane event rates

Reviewed maps of population weighted ZIP Code centroids statewide and for Santa Rosa and Osceola counties showing the impact on loss costs of the centroid updates.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

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

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

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

Audit

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

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

Modeler personnel, or their designated proxies, responsible for each aspect of the software (i.e. user interface, quality assurance, engineering, actuarial) shall be present when the Computer Standards are being audited. The Professional Team will interview internal users of the software.

Verified: YES

Professional Team Comments:

Reviewed the primary document binder that contains:

- flowcharts of the overall hurricane model
- data flow diagrams of the model components
- class inheritance diagrams
- engineering specifications
- test plans and procedures
- control flow diagrams
- Management Reorganization Document containing revised quality assurance (QA) scope and procedures
- details on the development process

Other documentation reviewed:

- RiskLink DLM User Guide
- RiskLink DLM Reference Guide
- RiskLink DLM System Administration Guide
- RiskLink Version 4.32a Release Notes
- RiskLink Mapping User Guide
- RiskLink Reports User Guide
- RMS U.S. Hurricane Model Methodology
- Secondary Modifier Design, Specification, and Code Implementation
- Pressure Calibration Design, Specification, and Code Implementation

C-2 Requirements

The modeler shall maintain a complete set of requirements for the model, its computer implementation, and all appropriate model documentation.

Audit

The documentation of the requirements specifications will be reviewed.

Verified: YES

Professional Team Comments:

Discussed in detail the process followed in development of the model, coding, testing, and implementation. Identified who has authorization to change the source code, and the procedures for tracking and verifying those changes. Discussed the procedures for changes made to the data.

Documentation reviewed:

- RiskLink v4.3a Product Definition
- RiskLink Functional Specification
- RiskLink Technical Specification
- RiskLink System Administration Manual that lists resource, security, and database requirements
- Visual SourceSafe Introduction and Overview for security requirements
- RiskLink DLM User Guide that summarizes the interface and functionality requirements
- Coding Standards detailing technical requirements for user interface, human factors design, source code design and implementation, database design and coding, and component interface design

C-3 Model Architecture and Component Design

The modeler shall maintain information defining the model architecture and design of model components and sub-components.

Audit

The following will be reviewed:

1. Detailed control and data flow diagrams,
2. Interface specifications for all components in the model,
3. Documentation for schemas for all data files, along with field type definitions,
4. Each network diagram including components, sub-component diagrams, arcs, and labels.

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

Verified: YES

Professional Team Comments:

Component Custodian documentation included both primary and backup (secondary) custodians. Discussed in detail the methodology for changes made to the source code and the security system in place.

Documentation reviewed:

- Class Diagrams
- General Class Diagrams
- Component Diagrams
- Flow Charts
- Data Flow Diagrams and Data Dictionary
- Component Custodians at the primary and secondary levels
- Most Recent Change by Component

C-4 Implementation

The software shall be traceable from the flow diagrams down to the code level.

Audit

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

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

The interfaces and the coupling assumptions will be reviewed.

Verified: YES

Professional Team Comments:

Performed spot checks on:

1. Visual Basic code for an Excel macro responsible for secondary modifiers (vulnerability);
2. Fortran source code for pressure calibration and inland decay; and
3. C++ source code for RiskLink 4.32a.

Documentation reviewed:

- Component Diagrams
- Data Flow Diagrams and Data Dictionary
- StormIND.US file containing storm rates for Florida

C-5 Verification

A. General

The modeler shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness.

B. Testing

Tests shall be performed for each software component, independent of all other components, to ensure that each component provides the correct response to inputs. The modeler shall use testing software to assist in documenting and analyzing all component test procedures and cases.

Audit

The code 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.

The testing of each component will be reviewed.

Verified: YES

Professional Team Comments:

Documentation reviewed:

- Sample C++ Source Files
- RiskLink 4.3a Test Procedures – MR Input Test Suite
- RiskLink 4.3a Mapping Test Plan
- Product Delivery Overview that illustrates the role of the review and testing within the development process
- Documentation templates and functional specifications
- Technical Specification that illustrates unit testing done by software developers
- Sample Fortran Source Code Verification Test for pressure calibration procedure
- Test Plan for secondary modifiers

C-6 Model Maintenance and Revision

A. The modeler shall have developed and implemented a clearly written policy for model revision with respect to methodologies and data.

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

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

Audit

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

Verified: YES

Professional Team Comments:

Documentation reviewed:

- Product Delivery Overview
- Sample Visual Intercept Incident Report from RiskLink Visual Intercept Database
- Visual Intercept Quick Reference Guide
- File Versioning
- Client Response System

C-7 Security*

*(*New Standard)*

The modeler shall have implemented security procedures for access to code, data, and documentation in accordance with standard industry practices.

Audit

Provide a written policy for all procedures and methods used to ensure the security of code, data, and documentation. Specify all security procedures.

Verified: YES

Professional Team Comments:

Reviewed and discussed RMS code, data, and security policy documentation.