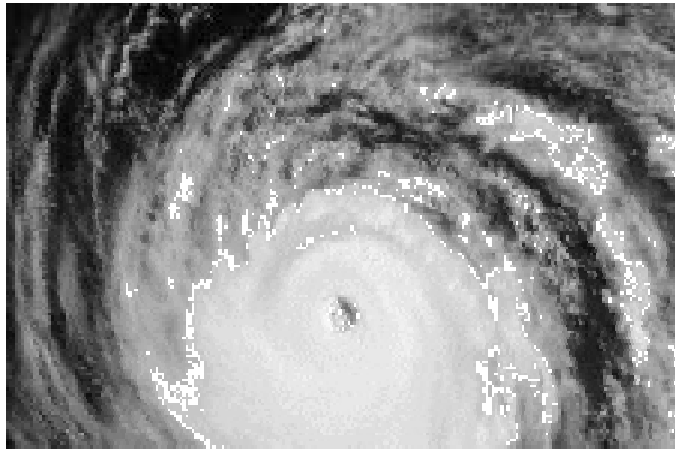


Florida Commission on Hurricane Loss Projection Methodology



Professional Team Audit Report

**Risk Management Solutions, Inc.
(RMS)**

**On-Site Review
May 2, 2001**

On May 2, 2001, the Professional Team visited on-site at Risk Management Solutions, Inc.(RMS) in Newark, California. The following people participated in the review:

RMS

Rick Anderson, FCAS, MAAA, Chief Actuary
James Grant, FCAS, Lead Risk Quantification Researcher, Actuarial & Financial Modeling
Guy C. Morrow, S.E., Vice President, Principal Engineer
John Reiter, Vice President, Software Development
Atul C. Khanduri, Ph.D., Program and Project Manager
Michael Drayton, Ph.D., Principal Modeller
Mohan P. Sharma, Ph.D., Lead Engineer

Professional Team

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

The review began with introductions and an overview of the audit process. RMS gave a brief overview of the 2000 model.

Statistical expertise at RMS is distributed over a number of individuals with varying professional backgrounds. RMS indicated that they do not have a designated individual with an advanced degree in statistics who is responsible for the statistical content of their submission and the statistical underpinnings or evaluation of their model. In the course of our on-site one-day review, certain items of a statistical content were presented by RMS and then subsequently withdrawn or amended. For example, a revision to some problems noted in our e-mail correspondence (4/6/01) had not been corrected in the prepared response for our on-site review.

In light of the above discussion, we note that RMS does not have on staff nor did they use a consultant having an advanced degree in statistics to review the statistical aspects of their model as evidenced in their submission. This discussion is the basis for not verifying 5.1.2.

Florida Commission on Hurricane Loss Projection Methodology

2000 Standards

5. 1 General Standards – Mark Johnson, Leader

5.1.1 Scope of the Computer Model and Its Implementation

The computer model shall project loss costs for personal lines residential property from hurricane events, excluding flood and storm surge, except as flood and storm surge apply to Additional Living Expense (ALE). References to the model throughout the Standards shall include its implementation.

Proprietary: **Yes**
Verified: **Yes**

Pro Team Comments:

No change from last year.

5.1.2 Qualifications of Modeler Personnel and Independent Experts

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.

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 or Member of the American Academy of Actuaries), meteorology (advanced degree), and computer science/engineering (advanced degree). Where applicable, these individuals shall abide by the standards of professional conduct adopted by their profession.

Reference: Module 2, Section I, #2-#3

(pages 76-89)

Reference: Module 2, Section I, #5

(pages 91-93)

Proprietary: **No**
Verified: **No**

Pro Team Comments:

Reviewed following vitas:

- Michael Drayton, Ph.D., Principal Modeler
- Atul C. Khanduri, Ph.D., Program and Project Manager
- Mohan P. Sharma, Ph.D., Lead Engineer

See comments in introduction.

5.1.3 Modelers Policy of Model Revision

The modeler shall have developed and implemented a clearly written policy for model revision with respect to methodologies and data. The modeler shall clearly identify the model version under review.

Reference: Module 1, Section I, A.1 (page 38)

Reference: Module 1, Section I, A.9 (page 55)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

No change from last year. Reviewed in context of computer standards.

5.1.4 Independence of Model Components

The meteorology, vulnerability, and actuarial components of the model shall each be demonstrated to 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 demonstrated to be reasonable.

Reference: Module 1, Section II, B.11 (page 71)

Reference: Module 1, Section II, B.13-15 (pages 71-72)

Reference: 5.5.3 (page 32)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

5.1.5 Geographic Location

Zip codes used in the model shall be updated at least every 24 months using information originating from the United States Postal Service.

Zip code centroids shall be derived by using either population or geography and shall be visually demonstrated to be reasonable.

If the model uses geographic location at a more refined level than zip code (e.g., latitude/longitude), such uses shall be visually demonstrated to be reasonable.

Reference: Module 3, Section VI, #1-#2

(pages 118-119)

Reference: Module 3, Form A

(page 123)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Reviewed maps of population centroids indicated within zip code boundaries.

5.1.6 Identification of Units of Measure of the Model

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

Reference: Module 1, Section I, C.2

(page 58)

Proprietary: No

Verified: Yes

Pro Team Comments:

User manual describing RMS protocol.

5.1.7 Visual Presentation of Data

Visualizations shall be accompanied by legends and labels for all elements. Individual elements shall be clearly distinguishable, whether presented in original or copy form.

- a. For data indexed by latitude and longitude, by county or by zip code, a color contour map and a continuous tone map with superimposed county and zip code boundaries shall be produced.

- b. Florida Map Colors: Maps will use two colors, blue and red, along with shades of blue and red, with dark blue and dark red designating the lowest and highest quantities, respectively. The color legend and associated map shall be comprised of an appropriate number of intervals to provide readability.

Proprietary: **Yes**
Verified: **Yes**

Pro Team Comments:

Reviewed color-coded maps.

5.1.8 Disclosure of User Supplied Input

A modeler shall clearly disclose, in a model output report, the specific type of input which is required of insurers in order to use the model in a residential property insurance rate filing. Such input includes, but is not limited to, optional features of the model, type of data to be supplied by the insurer and needed to derive loss estimates from the model, and any variables which a licensed user is authorized to set in implementing the model.

Proprietary: **Yes**
Verified: **Yes**

Pro Team Comments:

Reviewed the RiskLink® DLM User Guide, System Administration Manual, and DLM Reference Guide and Country Model Profiles.

5.2 Meteorological Standards – Tom Schroeder, Leader

5.2.1 Units of Measure for Model Output

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

Proprietary: **No**
Verified: **Yes**

Pro Team Comments:

Verified in materials presented throughout the review. Reviewed IRAS Version 3.6, U.S. Hurricane Changes.

5.2.2 Damage Function Wind Inputs

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 which are supported by literature and/or documented measurements available to the Commission.

Reference: Module 3, Section II, #2

(page 103)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

No change from last year.

5.2.3 Official Hurricane Set or Suitable Approved Alternatives

Modelers shall include in their base storm set all hurricanes, including by-passing hurricanes, which produce hurricane force winds in Florida. The storm set shall be taken from the Tropical Prediction Center/National Hurricane Center (TPC/NHC) document *Tropical Cyclones of the North Atlantic Ocean, 1871-1998* updated through the 1999 hurricane season or later. All proposed alternatives to the characteristics of specific storms in the storm set shall be subject to the approval of the Commission.

Reference: Module 1, Section II, B.7-8

(page 70)

Reference: Module 3, Section I

(page 94)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Confirmed that RMS storm set matches that provided by the Commission.

5.2.4 Hurricane Characteristics

Methods for depicting all modeled hurricane characteristics (e.g., wind speed, minimum central pressure, radius of maximum winds, strike probabilities, and tracks) shall be based on information documented by scientific literature or modeler information accepted by the Commission.

Reference: Module 1, Section II, B.1-8 (pages 68-70)
Reference: Module 3, Section I (page 94)
Reference: Standard 5.6.1 (pages 35)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

RMS gave a presentation on RMS's Florida Hurricane Stochastic Model Development. RMS employed Dr. Rex Britter, Dept of Civil Engineering at Cambridge as a consultant during the development of the model. RMS uses historical information to check their Florida model, not to build it directly.

Further details were discussed and provided in the paper A Stochastic, "Basin-Wide" Model of Atlantic Hurricanes by Michael Drayton (referenced on page 47 of the submission).

Noted that calibration refers to checking against historical data.

5.2.5 Landfall Intensity

Models shall use maximum one-minute sustained 10-meter wind speed when defining hurricane landfall intensity. This applies both to the base storm set adopted in 5.2.3 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:

A scale from 1 to 5 that measures hurricane intensity.

Category	Winds (mph)	Central Pressure (mb)	Damage
1	74 - 95	≥ 980	Minimal

Category	Winds (mph)	Central Pressure (mb)	Damage
2	96 - 110	965 – 979	Moderate
3	111 - 130	945 – 964	Extensive
4	131 - 155	920 – 944	Extreme
5	Over 155	< 920	Catastrophic

Reference: Module 3, Section I,#1-#3
Reference: Standards 5.6.1 and 5.6.2

(pages 94-95)
(pages 35-36)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change - Saffir-Simpson intensity is not a parameter of the RMS model.

5.2.6 Hurricane Probabilities

Modeled hurricane probabilities shall reasonably match the historical record through 1999 for category 1 to 5 hurricanes, shall be consistent with those observed for each geographical area of Florida, and shall be displayed in vertical bar graphs. “Consistent” means: (1) spatial distributions of modeled hurricane probabilities shall accurately depict vulnerable coastlines in Florida; and (2) probabilities are compared with observed hurricane frequency using methods documented in accepted scientific literature or proposed by the modeler and accepted by the Commission.

Reference: Module 1, Section I, B.2
Reference: Module 1, Section II, B.7
Reference: Module 3, Section I
Reference: Standards 5.6.1 and 5.6.2

(page 56)
(page 70)
(page 94)
(pages 35-36)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed series of tests on goodness of fit of CAT Fund rates in Florida, comparisons of historical and stochastic CDFs of translation speed and central pressure, landfall rates, and exit rates.

5.2.7 Hurricane Probability Distributions

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 as documented in accepted scientific literature available to the Commission.

Reference: Module 1, Section II, B.1 (page 68)
Reference: Module 1, Section II, B.7-8 (page 70)
Reference: Module 3, Section 1, #2 (page 94)
Reference: Module 3, Section 1, #8 (page 98)
Reference: Standards 5.6.1 and 5.6.2 (pages 35-36)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed details of SST based methodology and event probabilities.

5.2.8 Land Friction

Land friction shall be used in the model to reduce wind speeds over land, shall be based on scientific methods, and shall provide realistic wind speed transitions between adjacent zip codes, counties, and territories. The magnitude of friction coefficients shall be consistent with accepted scientific literature, consistent with geographic surface roughness, and shall be implemented with appropriate geographic information system data.

Reference: Module 1, Section II, B.4-5 (page 69)
Reference: Module 3, Section I (page 94)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year. Reviewed land friction maps.

5.2.9 Hurricane Overland Weakening Rate

The hurricane overland weakening rate used by the model shall be bounded by the observed extremes in historical records for Florida. The mean wind speed shall be within twenty percent (20%) of the Kaplan/DeMaria decay value or an alternative acceptable to the Commission.

Reference: Module 1, Section II, B.3

(page 69)

Reference: Module 3, Section I

(page 94)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

RMS demonstrated to the Professional Team their compliance within 20% of the Kaplan/DeMaria filling rate model.

5.3 Vulnerability Standards – **Fred Stolaski, Leader**

5.3.1 Derivation of Vulnerability Functions

The method of derivation of the vulnerability functions shall be described and demonstrated to be theoretically sound.

Development of the vulnerability functions is to be based on one or more of the following: (1) historical data; (2) tests; (3) structural calculations; (4) expert opinion. Any development of the vulnerability functions based on structural calculations and/or expert opinion shall be supported by tests and historical data to the extent such data are available.

Reference: Module 1, Section I, A.8

(page 54)

Reference: Module 3, Section III

(page 104)

Reference: Standard 5.6.1

(page 35)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Reviewed materials showing observed versus modeled losses. No change in vulnerability curves.

5.3.2 Required Vulnerability Functions

Vulnerability functions shall separately compute damages for building structures, mobile homes, appurtenant structures, contents, and additional living expense.

Reference: Module 3, Section III

(page 104)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year.

5.3.3 Wind Speeds Causing Damage

Damage associated with a declared hurricane event shall include damage incurred for wind speeds above and below the hurricane threshold of 74 mph. The minimum wind speed that generates damage shall be specified.

Reference: Module 3, Section III

(page 104)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year.

5.3.4 Construction Characteristics

In the derivation and application of vulnerability functions, assumptions concerning construction type and construction characteristics shall be demonstrated to be reasonable and appropriate.

Reference: Module 1, Section I, A.7

(pages 53-54)

Reference: Module 3, Section III

(page 104)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed spreadsheet showing exposure and loss data in Florida for various storms.

5.3.5 Modification Factors

Modification factors to the vulnerability functions or structural characteristics and their corresponding effects shall be disclosed and shall be clearly defined and their theoretical soundness demonstrated.

Reference: Module 3, Section III,#3 (page 104)

Reference: Module 3, Section III, #6 (page 105)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Discussed details on the modification factors available for building characteristics or mitigation measures. Reviewed development of modifiers for mitigation measures (i.e. shutters).

Reviewed the following documentation:

- SBCCI Test Standard for Determining Impact Resistance from Windborne Debris, SSTD 12-99
- Hurricane Damage to Residential Structures: Risk and Mitigation by Jon K. Ayscue
- HUD-8672
- Windstorm Mitigation Manual for Light Frame Construction, August 1997
- Building Performance: Hurricane Andrew in Florida by FEMA
- Performance of Roofing Systems in Hurricane Hugo by McDonald & Smith, IDR, Texas Tech
- APA Report T92-21
- Assessment of Damage to Single-Family Homes Caused by Hurricanes Andrew and Iniki by HUD
- South Florida Mitigation Baseline Survey Report, Volumes 1 and 2, by Peacock, Morrow, and Gladwin, FIU
- Technical Publication, The Effectiveness of Hurricane Shutters in Mitigating Storm Damage by FIU

Reviewed the following codes:

- ASCI 7-98
- SBCCI SSTD 10-99

- Guide to ASCE 7-95
- International Residential Code (2000)
- International Building Code (2000)

5.3.6 Additional Living Expenses

In the estimation of Additional Living Expenses (ALE), the model shall consider hurricane damage including storm surge damage to the infrastructure.

The Additional Living Expense vulnerability function shall consider the time it will take to repair/reconstruct the home.

Reference: Module 3, Section IV, #5-#6

(pages 107-108)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed details on development of ALE loss functions. RMS will addend submission to indicate the vulnerability function considers the time it will take to repair/reconstruct the home.

5.3.7 Mitigation Measures

Modeling of mitigation measures to improve a building's wind resistance and the corresponding effects on vulnerability shall be disclosed and demonstrated to be theoretically sound.

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Discussed details on the development of mitigation measures. Items reviewed listed under 5.3.5

5.4 Actuarial Standards – Marty Simons, Leader

5.4.1 Underwriting Assumptions

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. The methods used shall be documented in writing.

For damage estimates derived from historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, and (3) relevant underwriting practices underlying those losses shall be identified and demonstrated to be reasonable and appropriate.

Reference: Module 1, Section I, B.4 (page 56)
Reference: Module 1, Section II, A.3-5 (pages 67-68)
Reference: Module 3, Section IV (page 106)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year.

5.4.2 Actuarial Modifications

All modification factors to the actuarial functions or characteristics including but not limited to building code, quality, age, occupancy, stories, or condition of structure and their corresponding affects shall be disclosed and shall be clearly defined and their actuarial soundness demonstrated. The disclosure of modification shall include a description of the impact upon loss costs of the modification in accordance with the following:

- A: < -50%.
- B: -50% to -25%
- C: -25% to 0
- D: 0 to 25%
- E: 25% to 50%
- F: > 50%

Reference: Module 1, Section I, A.6 (page 53)
Reference: Module 1, Section I, A.10 (page 55 & 51)

Reference: Module 1, Section I, C.1.c

(page 57)

Reference: Module 3, Section III, #3

(pages 104)

Proprietary: Yes**Verified: Yes****Pro Team Comments:**

Reviewed details on the development of modification factors.

5.4.3 Loss Cost Projections

Loss cost projections produced by hurricane loss projection models shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin. Hurricane loss projection models shall not make a prospective provision for economic inflation.

Reference: Module 1, Section I, B.4

(page 56)

Reference: Module 1, Section I, C.1.a

(page 57)

Reference: Module 3, Section III, #2

(page 104)

Reference: Module 3, Section V

(page 112)

Reference: Module 3, Section VII

(page 120)

Proprietary: Yes**Verified: Yes****Pro Team Comments:**

No change from last year.

5.4.4 Insurer Inputs

The modeler shall disclose any assumptions, fixed and variable, that relate to insurer input. Such assumptions shall be demonstrated to be actuarially sound. Assumptions that can vary by specific insurer shall be disclosed in a model output report. Fixed assumptions, that do not vary, need to be disclosed to the Commission.

Reference: Module 1, Section I, A.10

(page 55 & 51)

Reference: Module 1, Section I, B.4

(page 56)

Reference: Module 1, Section II, A.3-4

(page 67)

Reference: Module 3, Section IV

(page 106)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year. No new insurer data.

5.4.5 Demand Surge

Loss cost projections shall not explicitly include demand surge. Any adjustment to the model or historical data to remove implicit demand surge shall be disclosed.

Reference: Module 1, Section I, C.1.a (page 57)

Reference: Module 3, Section III, #2 (page 104)

Reference: Module 3, Section VII (page 120)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Verified that demand surge is not included. Verified exclusion of demand surge from Andrew data.

5.4.6 Loss Costs - Meaning of “Damage”

In calculating loss costs, damage shall be expressed as insurable losses.

Reference: Module 1, Section II, A.5 (pages 67-68)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Loss costs are expressed as insured losses.

5.4.7 Logical Relation to Risk

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.

1. Loss costs produced by the model shall be positive and non-zero for all zip codes.
2. Modelers shall produce color-coded maps for the purpose of comparing loss costs by five-digit zip code within each county and on a statewide basis.
3. Loss costs cannot increase as friction or roughness increase, all other factors held constant.
4. Loss costs cannot increase as the quality of construction type, materials, and workmanship increases, all other factors held constant.
5. If the model considers the presence of fixtures or construction techniques designed for hazard mitigation, then the loss costs cannot increase above those in the absence of such measures, all other factors held constant.
6. Loss costs shall decrease as deductibles increase, all other factors held constant.
7. If the model considers the quality of building codes and enforcement, then loss costs cannot increase as the quality increases, all other factors held constant.

The above tests are intended to apply in general. There may be certain anomalies that are insignificant or are explainable by special circumstances. This standard applies separately to each coverage.

Reference: Module 1, Section I, C.1.b (page 57)
Reference: Module 3, Section V, #2 (pages 112-114)
Reference: Module 3, Section V, #5 (page 117)
Reference: Module 3, Section VII (page 120)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed construction characteristics criteria.

5.4.8 Deductibles

The model shall provide a mathematical representation of the distribution of losses to reflect the effects of deductibles and coinsurance, and the modeler shall demonstrate its actuarial soundness.

Reference: Module 1, Section I, B.3 (page 56)

Reference: Module 3, Section IV, #1-#2 (page 106)

Reference: Standard 5.6.1 (page 35)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Details were provided in support of the beta distribution. Figure 5.7, Example Loss Distribution, is a pdf curve.

5.4.9 Contents

The model shall provide a separate mathematical representation of contents loss costs, and the modeler shall demonstrate its actuarial soundness.

Reference: Module 3, Section IV, #5 (pages 107-108)

Reference: Module 3, Section IV, #7 (page 108)

Reference: Standard 5.6.1 (page 35)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

RMS uses actual contents loss data.

5.4.10 Additional Living Expenses (ALE)

The model shall provide a separate mathematical representation of Additional Living Expense (ALE) loss costs, and the modeler shall demonstrate its actuarial soundness.

Reference: Module 3, Section IV, #6 (page 108)

Reference: Standard 5.6.1 (page 35)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed details on development of ALE loss functions.

5.4.11 Building Codes

Information upon which building code quality and enforcement is assessed, if incorporated in the model, shall be objective and reasonably accurate and reliable.

Reference: Module 1, Section I, C.1.b (page 57)
Reference: Module 3, Section III, #3 (page 104)
Reference: Standard 5.6.1 (page 35)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year.

5.4.12 Hazard Mitigation

Data or information upon which differences in loss costs due to fixtures, design features, or construction techniques designed for hazard mitigation are derived, if incorporated in the model, shall be objective and actuarially reasonable.

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed details on the development of mitigation measures.

5.4.13 Replication of Known Hurricane Losses

The model shall be shown to 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 mobile homes to the extent data are available. Personal residential experience may be used to replicate building-only and contents-only losses. The modeler shall demonstrate that the replications were produced on an objective body of loss data by county or an appropriate level of geographic detail.

Reference: Module 3, Section IV, #9 (pages 108-111)
Reference: Module 3, Section V, #2 (pages 112-114)
Reference: Standard 5.6.2 (page 36)

Proprietary: No
Verified: Yes

Pro Team Comments:

Discussed and reviewed material contained in submission.

5.4.14 Comparison of Estimated Hurricane Loss Costs

The model shall provide the annual average statewide loss costs produced using the list of hurricanes in standard 5.2.3 historical hurricanes in Florida based on the 1998 Florida Hurricane Catastrophe Funds (FHCF) aggregate exposure data, as of November 1, 1999. These will be compared to the statewide loss costs produced by the model on an average industry basis. The difference, due to uncertainty, between historical and modeled annual average statewide loss costs shall be demonstrated to be statistically reasonable.

Reference: Module 3, Section I, #7 (page 97)
Reference: Module 3, Section I, #10 (page 99)
Reference: Module 3, Section V, #2 (pages 112-114)
Reference: Module 3, Section V, #4 (page 131)
Reference: Standard 5.6.2 (page 36)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed details for statistical reasonableness.

5.4.15 Output Ranges

Any model previously found acceptable by the Commission shall provide an explanation suitable to the Commission concerning the updated output ranges. Differences between the prior year submission and the current submission shall be explained in the submission.

Reference: Module 3, Section V, #4-#5

(pages 117 & 131)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed changes in outputs from previous year and verified they are only attributable due to the revised storm track model and to the annual event set updating.

5.4.16 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 demonstrated to be negligible.

Reference: Module 1, Section II, C.2

(pages 72-73)

Reference: Standard 5.6.2

(page 36)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed material in support of verification.

5.5 Computer Standards – **Paul Fishwick, Leader**

5.5.1 Primary Document Binder

A primary document binder shall be created and shall contain fully documented sections for each subsequent Computer Standard. Development of each section shall be indicative of accepted software engineering practices.

Reference: Module 1, Section I

(page 38)

Reference: Module 1, Section II

(page 63)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Reviewed the primary document binder, which contained flowcharts of the overall hurricane model, data flow diagrams of the model components, diagrams of class inheritance, other class properties, and engineering specifications.

5.5.2 Requirements

The modeler shall document all requirements specifications of the software, such as interface, human factors, functionality, documentation, data, human and material resources, security, and quality assurance.

Reference: Module 1, Section I

(page 38)

Reference: Module 1, Section II

(page 63)

Reference: Module 3, Section VI, #3

(page 119)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- RiskLink® v4.2 Product Definition, Feature #2643 (includes user interface documentation)
- RiskLink Functional Specification, US Manual File Import #2643

5.5.3 Component Design

The modeler shall document detailed computer-printed diagrams for control and data flow, and a schema for all data files along with field type definitions. Each network diagram shall contain components, arcs, and labels. At the topmost design level, detailed input and output interface specifications, including data types, shall be specified for each of the model's components.

Reference: Module 1, Section I

(page 38)

Reference: Module 1, Section II

(page 63)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- HU Class Diagrams
- General Class Diagrams
- Component Diagrams
- HU DLM Flow Charts
- Data Flow Diagrams and Data Dictionary

5.5.4 Implementation

The software shall be traceable from the flow diagrams and their components down to the code level. All documentation, including document binder identification, shall be indicated in the relevant component. The highest design level components shall incrementally be translated into a larger number of components until the code level is reached.

Reference: Module 1, Section I

(page 38)

Reference: Module 1, Section II

(page 63)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed following documentation:

- Component Diagrams
- Data Flow Diagrams and Data Dictionary

5.5.5 Software Verification

The modeler shall employ verification procedures, such as code inspections, reviews, and walkthroughs, sufficient to demonstrate code correctness. The code shall contain sufficient logical assertions or flag-triggered output statements to test the correct values for key variables as they are modified.

Reference: Module 1, Section I

(page 38)

Reference: Module 1, Section II

(page 63)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- Sample C++ Source File With Assertions and Exception Handling (rmsdbase.cpp)

5.5.6 Testing

Tests shall be documented for each software component, independent of all other components, to ensure that each component provides the correct response to inputs. All components when interfaced shall function correctly.

Reference: Module 1, Section I (page 38)

Reference: Module 1, Section II (page 63)

Reference: Standards 5.6.3 and 5.6.4 (pages 36-37)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- RiskLink 4.2 Test Procedures – Manual Import from File Test Suite

5.5.7 Software Maintenance and Revision

The modeler shall specify all policies and procedures used to maintain the software. The modeler shall use source revision software to track code modifications.

Reference: Module 1, Section I (page 38)

Reference: Module 1, Section II (page 63)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- Product Delivery Overview
- Sample Incident Report From RiskLink Visual Intercept Database
- Visual Intercept Quick Reference Guide
- File Versioning

5.5.8 User Documentation

The modeler shall have complete user documentation including all recent updates.

Reference: Module 1, Section I

(page 38)

Reference: Module 1, Section II

(page 63)

Proprietary: Yes

Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- RiskLink DLM User Guide
- RiskLink DLM Reference
- RiskLink DLM System Administration
- RiskLink Version 4.1 SP3 Release Notes

5.6 STATISTICAL STANDARDS – Mark Johnson, Leader**5.6.1 Comparison of Historical and Modeled Results**

In situations where a modeler uses historical data to develop a modeled counterpart, the modeler shall demonstrate the goodness-of-fit of the modeled results to the historical data using accepted scientific and statistical methods.

Proprietary: Yes

Verified: No

Pro Team Comments:

Not verified pending verification of 5.1.2.

5.6.2 Characterizing Uncertainty

In cases where a statistical estimate is given, the modeler shall also provide an assessment of the attendant uncertainty.

Proprietary: **Yes**
Verified: **No**

Pro Team Comments:

Not verified pending verification of 5.1.2.

5.6.3 Sensitivity Analysis for Model Output

The modeler shall demonstrate that the model has been assessed with respect to sensitivity of temporal and spatial outputs to the simultaneous variation of input parameters. Statistical techniques used to perform sensitivity analysis shall be explicitly stated and results demonstrated in graphical format.

Reference: Module 1, Section II, B.13-15

(pages 71-72)

Proprietary: **Yes**
Verified: **No**

Pro Team Comments:

Not verified pending verification of 5.1.2.

5.6.4 Uncertainty Analysis for Model Output

The modeler shall demonstrate that the temporal and spatial outputs of the model have been subjected to an uncertainty analysis. Such an analysis will identify and quantify the input parameters that impact the uncertainty in model output when the input parameters are simultaneously varied. Statistical techniques used to perform uncertainty analysis shall be explicitly stated and results demonstrated in graphical format.

Reference: Module 1, Section II, B.13-15

(pages 71-72)

Proprietary: **Yes**
Verified: **Yes**

Pro Team Comments:

Approach used was reviewed.