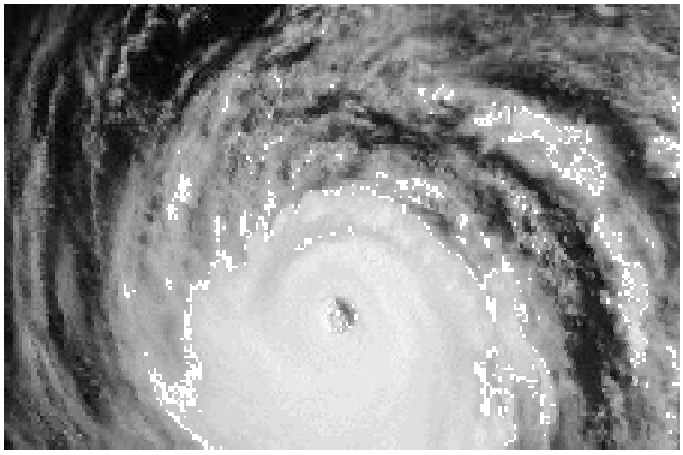
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Audit Report

EQECAT, Inc.

On-Site Review
May 3, 2001

On May 3, 2001, the Professional Team visited on-site at EQECAT, Inc. in Oakland, California. The following people participated in the review:

EQECAT

Mahmoud M. Khater, Ph.D., P.E., Senior Vice President
David F. Smith, Associate
Richard L. Clinton, CPCU, Vice President
Richard W. Mensing, Ph.D., Senior Consultant Catastrophe Management
Michael A. Vallejos, President
Shawna S. Ackerman, FCAS, MAAA, Principal and Consulting Actuary, Miller, Herbers, Lehmann & Assoc. Inc. and Paratus Consulting Limited
Omar Khemici, Ph.D., P.E., Group Manager
Tom Larsen, Structural Engineering, Software Design
Bob Bailey, Ph.D., Wind and Structural Engineer (via phone)
Ray Kincaid, Software Development (via phone)

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. EQECAT gave a presentation on the model changes since the February 2000 submittal and the effect of those changes on statewide loss costs.

EQECAT provided a PowerPoint presentation of their compliance to each of the 2000 Standards. This presentation included a response to every point raised in the 4/6/01 electronic correspondence. Further supporting materials were brought up on demand.

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

Pro Team Comments:

Reviewed details on exclusion of flood and storm surge.

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 34-37)
Reference: Module 2, Section I, #5 (pages 38-41)

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

Pro Team Comments:

The EQECAT team has not changed since the previous submittal.

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 1)
Reference: Module 1, Section I, A.9 (page 16)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed EQECAT's documentation for model revision in regards to methodologies and data. Specific changes were considered in the course of reviewing the 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 28)
Reference: Module I, Section II, B.13-15 (pages 28-29)
Reference: 5.5.3 (page 135)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

The changes made since the previous submission did not impact independence nor reasonableness of relationships among the components.

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 90-92)
Reference: Module 3, Form A (page 96)

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

Pro Team Comments:

Reviewed maps of population centroids indicated within zip code boundaries. Examined specific zip codes as needed. All cases were adequately explained.

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 20)

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

Pro Team Comments:

All materials examined during the on-site review were clearly defined with respect to model inputs and outputs.

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:

Verified that all visualizations presented during the visit had the required characteristics. 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 examples of user input options.

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:

Demonstrated by sample model outputs.

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 60)

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 25)
Reference: Module 3, Section I (page 43)

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

Pro Team Comments:

Verified EQECAT's storm set matches that provided by the Commission.
Discussed details of revised Commission storm set.

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 22-25)
Reference: Module 3, Section I (page 43)
Reference: Standard 5.6.1 (page 138)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year.

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	$\geq$ 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

Reference: Module 3, Section I,#1-#3 (pages 43-44)
Reference: Standards 5.6.1 and 5.6.2 (page 138)

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

Pro Team Comments:

The Professional Team was shown details on the agreements between the USWIND® pressure-wind speed relationship generated wind speeds and the Saffir-Simpson category definition.

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 (page 17)
Reference: Module 1, Section II, B.7 (page 25)
Reference: Module 3, Section I (page 43)
Reference: Standards 5.6.1 and 5.6.2 (page 138)

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

Pro Team Comments:

Reviewed details on the correlation between USWIND storm frequencies and actual landfalls.

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 22)
Reference: Module 1, Section II, B.7-8 (page 25)
Reference: Module 3, Section 1, #2 (pages 43-44)
Reference: Module 3, Section 1, #8 (pages 47-48)
Reference: Standards 5.6.1 and 5.6.2 (page 138)

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

Pro Team Comments:

No change, based on historical data.

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 (pages 23-25)
Reference: Module 3, Section I (page 43)

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

Pro Team Comments:

Reviewed land friction maps to assess the USWIND® land friction database.

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 23)
Reference: Module 3, Section I (page 43)

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

Pro Team Comments:

EQECAT 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 15)
Reference: Module 3, Section III (page 62)
Reference: Standard 5.6.1 (page 138)

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

Pro Team Comments:

Reviewed details on the development and the data input for the vulnerability functions.

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 62)

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

Pro Team Comments:

Reviewed details on the vulnerability functions.

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 62)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the source code for identification of 40 mph as threshold for damage.

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 14-15)
Reference: Module 3, Section III (page 62)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

No change from last year.

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 (pages 63-64)
Reference: Module 3, Section III, #6 (pages 64-65)

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

Pro Team Comments:

Reviewed modification factors.

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 69-71)

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

Pro Team Comments:

Verified estimated ALE is based solely on hurricane-related information from claims data. Addendum to be added to state that time to repair/reconstruct is considered.

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:

Reviewed actual steps in EQECAT's modeling of mitigation measures including details on modifier calculations. No new mitigation measures were added to the model this year.

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 18)
Reference: Module 1, Section II, A.3-5 (page 22)
Reference: Module 3, Section IV (page 66)

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

Pro Team Comments:

Reviewed process on reviewing claims data and correcting for data errors and anomalies.

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 14)
Reference: Module 1, Section I, A.10 (page 16-17)
Reference: Module 1, Section I, C.1.c (page 19)
Reference: Module 3, Section III, #3 (pages 63-64)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed during the vulnerability standards. Modifications not present in current model.

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 18)
Reference: Module 1, Section I, C.1.a (page 19)
Reference: Module 3, Section III, #2 (pages 62-63)
Reference: Module 3, Section V (page 76)
Reference: Module 3, Section VII (page 93)

Proprietary: No
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 (pages 16-17)
Reference: Module 1, Section I, B.4 (page 18)
Reference: Module 1, Section II, A.3-4 (page 22)
Reference: Module 3, Section IV (page 66)

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

Pro Team Comments:

Reviewed an example of a typical output report.

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 19)
Reference: Module 3, Section III, #2 (pages 62-63)
Reference: Module 3, Section VII (page 93)

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

Pro Team Comments:

Verified that demand surge was not used in preparing the loss cost projections.

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 (page 22)

Proprietary: **Some Proprietary**
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 19)
Reference: Module 3, Section V, #2 (pages 77-78)
Reference: Module 3, Section V, #5 (pages 83-85)
Reference: Module 3, Section VII (page 93)

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

Pro Team Comments:

Verified during review of vulnerability standards.

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 (pages 17-18)
Reference: Module 3, Section IV, #1-#2 (pages 66-68)
Reference: Standard 5.6.1 (page 138)

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

Pro Team Comments:

Reviewed details supporting the given distributions.

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 69-70)
Reference: Module 3, Section IV, #7 (page 71)
Reference: Standard 5.6.1 (page 138)

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

Pro Team Comments:

Reviewed methodology and data used to calculate damage to contents and derive vulnerability functions.

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 (pages 70-71)
Reference: Standard 5.6.1 (page 138)

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

Pro Team Comments:

Reviewed methodologies and data used to derive 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 19)
Reference: Module 3, Section III, #3 (pages 63-64)
Reference: Standard 5.6.1 (page 138)

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

Pro Team Comments:

No modifications are made based on building codes.

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:

No change from last year.

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 72-75)
Reference: Module 3, Section V, #2 (pages 77-78)
Reference: Standard 5.6.2 (page 138)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed comparisons of modeled insured losses to reported losses.

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 47)
Reference: Module 3, Section I, #10 (pages 51-55)
Reference: Module 3, Section V, #2 (pages 77-78)
Reference: Module 3, Section V, #4 (page 105)
Reference: Standard 5.6.2 (page 138)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Discussed t-tests conducted for comparisons.

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 83-85 & 105)

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

Pro Team Comments:

Reviewed changes from previous year and modeler disclosed and described the effect upon loss costs in several geographic locations. Reviewed mobile home changes.

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 30-31)
Reference: Standard 5.6.2 (page 138)

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

Pro Team Comments:

Modeler presented statistical analysis of sampling error at county level.

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 1)
Reference: Module 1, Section II (page 21)

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

Pro Team Comments:

Reviewed the primary document binder and the master list of reference documents.

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 1)
Reference: Module 1, Section II (page 21)
Reference: Module 3, Section VI, #3 (page 92)

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

Pro Team Comments:

Reviewed the following documentation on all requirements specifications of the software:

- USWIND Requirement Specification, Revision 1, August 25, 1994
- Design Specification EQECAT Additional Reports, February 1, 1999
- Design Specification EQECAT Additional Projects, Revision 2, June 30, 1999

Lotus Notes Database with the Following Documents:

- Primary Underwriter Module Hardware/Software Requirements, Revision 2, November 2, 2000

- Treaty Underwriter Module Hardware/Software Requirements, Revision 2, November 7, 2000
- Treaty Underwriter Module Software Requirements Specification (SRS) Volume 3 of 3, Preliminary Draft, September 12, 2000
- Treaty Underwriter Module Software Requirements Specification (SRS) Volume 1 of 3, Preliminary Draft, September 7, 2000
- Treaty Underwriter Module Software Requirements Specification (SRS) Volume 2 of 3, Preliminary Draft, September 7, 2000
- Treaty Underwriting Module Product Requirements Document, Revision 1.0.8, March 6, 2000
- WORLDCAT enterprise Version 2.0 Product Requirements Document, Revision 1.0.0, September 20, 2000

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 1)
Reference: Module 1, Section II (page 21)

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

Pro Team Comments:

Reviewed the following documentation on all design levels of the software, including software components and interfaces, data files, and database elements:

- EQECAT Catastrophe Management Output Reports Definitions, Revision 2, November 30, 1994
- EQECAT Catastrophe Management System, Version 3, GUI Design Specification, Revision 5, February 21, 1996
- EQECAT Natural Hazard Applications, Version 5, System Analysis and Data Flow Diagrams, Revision 2, December 1, 1998
- EQECAT Natural Hazard Applications, Version 5, System Design and Implementation, Revision 4, April 16, 2000
- EQECAT Natural Hazard Applications, Version 5, Interface Control Document, Revision 9, September 22, 2000
- EQECAT Data Dictionary Help File on CD-ROM
- Design Specification EQECAT Additional Reports, February 1, 1999

- Design Specification EQECAT Additional Projects, Revision 2, June 30, 1999
- EQECAT User Manual
- EQECAT Reference Guide
- EQECAT File Layout & Import Manual
- QA Test Procedure
- (Lotus Notes) Application Programmers Interface (API) for the EQECAT TUM Analysis Engine Broker, Revision 0, August 11, 2000
- (Lotus Notes) Treaty Underwriter Module Data Dictionary Modifications, Revision 0, September 27, 2000

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 1)
Reference: Module 1, Section II (page 21)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- USWIND Requirement Specification, Revision 1, August 25, 1994
- EQECAT Natural Hazard Applications, Version 5, System Design and Implementation, Revision 4, April 16, 2000
- EQECAT Catastrophe Management System, Version 3, GUI Design Specification, Revision 5, February 21, 1996
- EQECAT Natural Hazard Applications, Version 5, Interface Control Document, Revision 9, September 22, 2000
- (Lotus Notes) WORLDCAT enterprise Installation Guide, Revision 1, April 18, 2001

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 1
Reference: Module 1, Section II (page 21

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- Technical Reference, USWIND Version 4.0 to 5.x, December 1997-April, 2001.
- Technical Reference, Damage to Loss Calculation, USWIND and USQUAKE Version 4.0 to 5.x, December 1997-April, 2001.

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 1
Reference: Module 1, Section II (page 21
Reference: Standards 5.6.3 and 5.6.4 (pages138-139)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- QA Test Procedure
- Test Runs, Test Plan and Summary of Results.
- Test Runs, QA Verification of Scenario Wind Speed.
- Test Runs, QA Verification for Wind Speed and Damage Calculations,
- Test Runs, QA Verification for Scenario Damage Calculation.
- Test Runs, QA Verification for Scenario Gross Loss Calculation.
- Test Runs, QA Verification for Scenario Net Loss Calculation.
- Test Runs, QA Verification for Gross to Net Calculation.
- Test Runs, QA Verification for Probabilistic Gross Loss Calculation.
- Test Runs, QA Verification for Probabilistic Net Calculation.
- (Lotus Notes) Tum Technical Test Plan R. 4

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 1)
Reference: Module 1, Section II (page 21)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following documentation:

- QA Test Procedure
- SourceSafe

5.5.8 User Documentation

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

Reference: Module 1, Section I (page 1)
Reference: Module 1, Section II (page 21)

Proprietary: Yes
Verified: Yes

Pro Team Comments:

Reviewed the following user documentation:

- EQECAT User Manual
- EQECAT Reference Guide
- EQECAT File Layout & Import Manual
- EQECAT Data Dictionary Help File

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: **Yes**

Pro Team Comments:

Reviewed goodness-of-fit tests used to compare modeled distributions of various parameters with the underlying historical data.

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: **Yes**

Pro Team Comments:

Reviewed several examples of uncertainty estimates.

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 28-29)

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

Pro Team Comments:

Reviewed several sensitivity studies.

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 28-29)

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

Pro Team Comments:

Reviewed several uncertainty analyses.