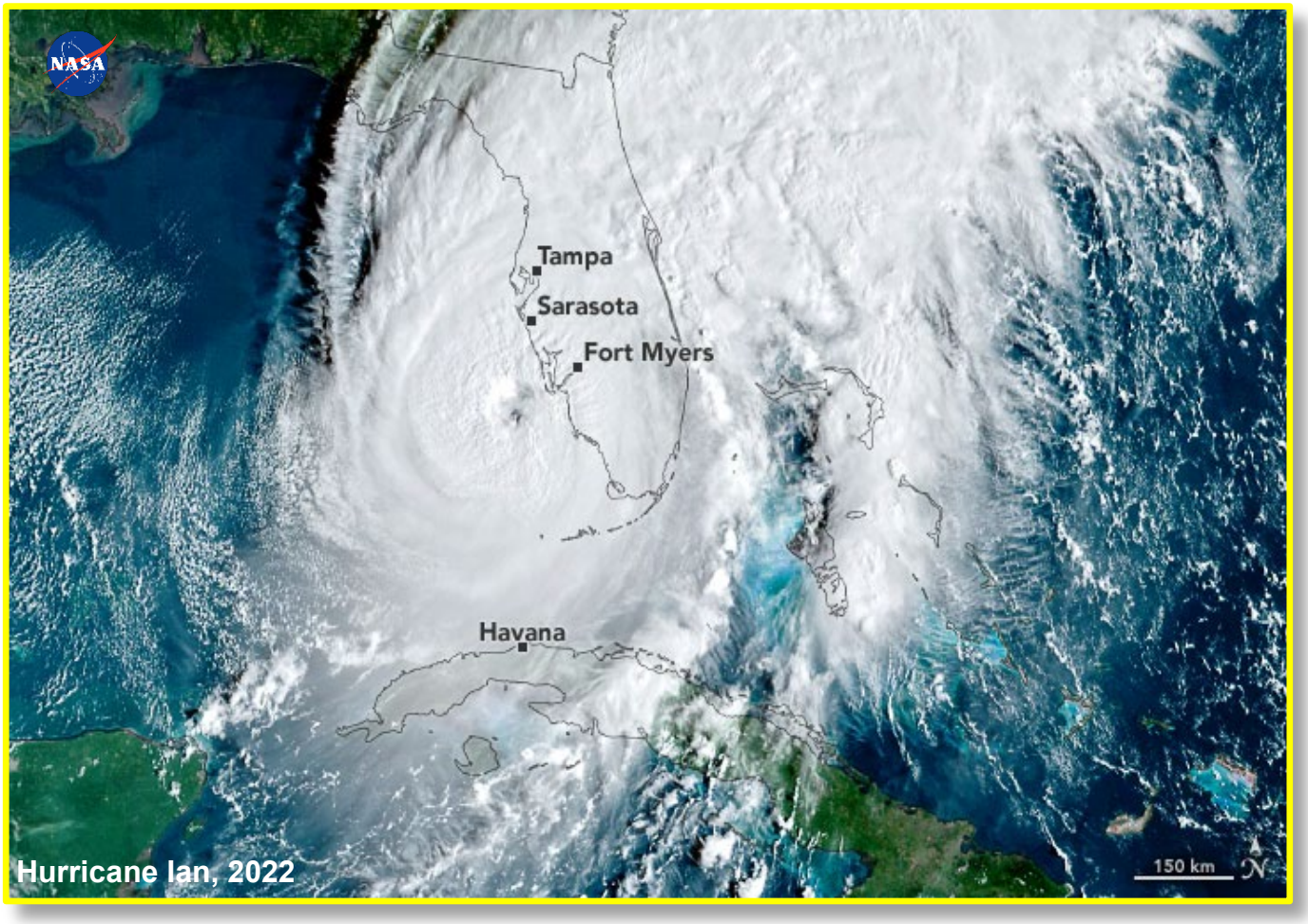
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report

2023 Hurricane Standards



Verisk

On-Site Review: March 24-27, 2025

Virtual Continuance: April 3, 2025

On March 24-27, 2025, the Professional Team conducted an on-site review of the Verisk Hurricane Model for the United States Version 3.0.0. The following individuals participated in the review.

Verisk

Siddhartha Kumar Arya, Manager, Information Security Group
Prajakta Rane Bhosle, Senior SQA Engineer
Julia Borman, Ph.D., Director, Consulting and Client Services
Robert Cabeca, External Independent Peer Reviewer
Murali Chittapragada, Senior Principal Engineer
Suryana Datla, Vice President
Burcu Davidson, Senior Vice President
S L Naga Jyotsna Dhanyamaraju, Lead Engineer
Thomas Diamond, Principal User Experience Designer
Paul Ericksen, FCAS, MAAA, External Independent Peer Reviewer
Nazanin Firouzbakht, Senior Consultant, Consulting and Client Services
Lindsey Fletcher, Risk Consultant, Consulting and Client Services
Carol Friedland, Ph.D., P.E., C.F.M., External Independent Peer Reviewer
Srimantha Ghosh, Manager
Isabelle Grenier, Ph.D., Senior Scientist, Climate Statistics
Anthony Hanson, Director of Analytics
Cheryl Hayes, Vice President
Harini Induri, Model QA Analyst
Aditya Jinna, Senior Manager, Software Development
Tim Johnson, Ph.D., Principal Engineer and Senior Manager, Research and Modeling
Mohan Kandulapati, Senior QA Engineer
Emma Kaplan, Manager, Model Quality Assurance
Connor King, Risk Consultant, Consulting and Client Services
Vladimir Kireyev, Director of Software Development
Aaron Knox, Senior Analyst, Data Technology Group
William Lamberson, Senior Quality Assurance Associate
Sylvie Lorsolo, Ph.D., Senior Principal Scientist and Senior Manager, Research and Modeling
Jianjun Luo, Principal Engineer
Evan McDonagh, Senior Software Engineer
Ram Nagulpally, Senior Vice President
Glen Patashnick, FCAS, Senior Actuarial Consultant, Consulting and Client Services
Sudhir Potharaju, Executive Vice President
Asha Prabhu, Senior Software Engineer, Software Development
Karthik Ramanathan, Ph.D., Vice President and Principal Engineer, Research and Modeling
Thomas Renault, Senior Analyst, Extreme Event Solutions
Indumathi Sagyari, Manager, Model Implementation
Harripprikesh Srinivasan, Senior Model QA Analyst
Scott Sperling, CCM, Manager, Model Quality Assurance
Sreedevi Srinivasan, Senior Quality Assurance Engineer
Steve Straight, Senior Manager, Documentation

Jeff Strong, Ph.D., Senior Scientist, Research
Ashwin Thillai, Senior Core Quality Assurance Associate
Srinivas Thoudoju, Lead Engineer, Software Development
Eric Uhlhorn, Ph.D., Principal Scientist, Research
Ramesh Ummati, Senior Principal Engineer
Satish Vootukuru, Lead Software Engineer, Model Implementation
Susan Tolwinski-Ward, Ph.D., Assistant Vice President and Director of Climate Statistics, Research and Modeling
Russell Winans, Principal Engineer, Research and Modeling

Professional Team

Mark Johnson, Ph.D., Statistics, Team Leader
Stu Mathewson, FCAS, MAAA, Actuarial
Kevin Moran, Ph.D., Computer/Information
Mark Powell, Ph.D., Meteorology
Masoud Zadeh, Ph.D., P.E., Vulnerability
Colin Zarzycki, Ph.D., Meteorology, observer
Donna Sirmons, Staff

Commission

Peggy Cheng, ACAS, Florida Office of Insurance Regulation Actuary
Kayne Smith, Ph.D., FCAS, Citizens Property Insurance Corporation

The Professional Team began the review with an opening briefing and introductions were made. Verisk indicated that Form S-4, Form S-5, Form A-2, and Form A-3 were revised and provided with the on-site review materials on March 20, 2025. Verisk stated that the incorrect historical event set had been used to complete the initial forms, and that the forms were revised with updated values to reflect the correct historical event set.

Verisk next provided an overview of the hurricane model changes.

- Historical storm set updated for 2021-2022 events
- Annual landfall frequency, landfall intensity, and associate data files updated
- Pre-computed factors for adjusting the base wind structural vulnerability when no year-built information is provided updated to be relevant through 2024
- Underlying year-built weighting assumptions for building stock age adjusted to utilize the latest census and tax assessor data
- Vulnerability adjustment accounting for structural aging, building technology changes, and aging and deterioration of roofs updated to be relevant through 2024
- Roof year-built secondary risk feature updated to be relevant through 2024
- ZIP Codes and ZIP dependent databases updated to April 2024

Verisk explained the impacts on loss costs for each of the model updates. The combined model updates resulted in an 8.1% increase in the average annual zero deductible statewide hurricane loss costs, with the largest individual increase of 7.7% attributed to the updates in the historical storm set and stochastic catalog.

The audit continued with a review of each standards section.

During the review of the meteorological component of the model, the order of operations in the calculation of hurricane surface winds was discussed, and the Professional Team wanted a further understanding of the methodology Verisk has been implementing in the model. A review of the source code revealed that the order of operations conforms to Verisk's documented approach.

Due to travel schedules, the Professional Team was unable to reach a consensus before the scheduled end of the on-site review on March 27, 2025. The Professional Team requested the Commission Chair grant an extension of the review for one day, and a continuance of the review was granted. The review continued virtually on April 3, 2025.

The following individuals participated in the virtual review on April 3, 2025.

Verisk

Julia Borman, Ph.D., Director, Consulting and Client Services
Nazanin Firouzbakht, Senior Consultant, Consulting and Client Services
Lindsey Fletcher, Risk Consultant, Consulting and Client Services
Isabelle Grenier, Ph.D., Senior Scientist, Climate Statistics
Jay Guin, Ph.D., Executive Vice President and Chief Research Officer
Aditya Jinna, Senior Manager, Software Development
Tim Johnson, Ph.D., Principal Engineer and Senior Manager, Research and Modeling
Connor King, Risk Consultant, Consulting and Client Services
William Lamberson, Senior Quality Assurance Associate
Sylvie Lorsolo, Ph.D., Senior Principal Scientist and Senior Manager, Research and Modeling
Glen Patashnick, FCAS, Senior Actuarial Consultant, Consulting and Client Services
Asha Prabhu, Senior Software Engineer, Software Development
Karthik Ramanathan, Ph.D., Vice President and Principal Engineer, Research and Modeling
Rob Newbold, President Extreme Event Solutions
Steve Straight, Senior Manager, Documentation
Jeff Strong, Ph.D., Senior Scientist, Research
Ashwin Thillai, Senior Core Quality Assurance Associate
Eric Uhlhorn, Ph.D., Principal Scientist, Research
Satish Vootukuru, Lead Software Engineer, Model Implementation
Susan Tolwinski-Ward, Ph.D., Assistant Vice President and Director of Climate Statistics, Research and Modeling

Professional Team

Mark Johnson, Ph.D., Statistics, Team Leader
Stu Mathewson, FCAS, MAAA, Actuarial
Kevin Moran, Ph.D., Computer/Information
Mark Powell, Ph.D., Meteorology
Masoud Zadeh, Ph.D., P.E., Vulnerability
Donna Sirmons, Staff

The Professional Team requests that Verisk present its modeling approach for calculating hurricane surface winds, including the order of operations, to the Commission during the trade secret session of the meeting to review the model for acceptability under the 2023 Hurricane Standards.

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the January 3, 2025, meeting. The deficiencies were eliminated by the established time frame, and the modifications have been verified.

1. S-5.1, pages 109-113: Incomplete. Hurricane Irma (2017) and Hurricane Michael (2018) analyses not provided.

2. V-1.4, page 123: Incomplete. Response to the second part of the disclosure not provided.

3. V-1.8, pages 125-127: Incomplete. The total number of building hurricane vulnerability functions not provided.

Professional Team Pre-Visit Letter

The Professional Team's pre-visit letter items are provided in the report under the corresponding standards. Following is the pre-visit letter preamble.

The purpose of this pre-visit letter is to outline specific issues unique to Verisk's model submission under the 2023 hurricane standards, and to identify lines of inquiry that will be followed during the on-site review in order to allow time for adequate preparation. Aside from due diligence with respect to the full submission, various questions that the Professional Team will ask during the on-site review are provided herein. This letter does not preclude the Professional Team from asking for additional information during the on-site review that is not given below or discussed during an upcoming conference call to be held if requested by Verisk. The goal of a potential conference call is to address your questions related to this letter or other matters pertaining to the on-site review. The overall intent is to help expedite the on-site review and to avoid last minute preparations that could have been undertaken earlier.

It is important that all material prepared for presentation during the on-site review be provided to the Professional Team and presented using a medium that is readable by all members of the Professional Team simultaneously.

The Professional Team will begin the review with an opening briefing. Verisk should then proceed with an explanation of new or updated material related to the model. Afterwards, a review of the standards in the *Hurricane Standards Report of Activities as of November 1, 2023,* will commence. Each standard should be addressed beginning with responses to the pre-visit letter questions for that specific standard followed by responses to each of the audit items for that standard. Verisk should discuss the Artificial Intelligence (AI) issue identified by the Commission at the January 3, 2025, meeting during the Computer Information Standards. The Professional Team will discuss with ARA the two Commission Inquiries regarding roof covering type and attachment, and building and roof vulnerability after the Professional Team exit briefing.

If changes have been made in any part of the model or the modeling process from the descriptions provided in the initial October 29, 2024, submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and any revised forms. For each revised form, provide an additional form with cell-by-cell differences between the revised and the original submitted values.

Refer to the On-Site Review chapter of the *Hurricane Standards Report of Activities as of November 1, 2023*, for details on materials to be presented and provided to the Professional Team (pages 94-96).

While the Report of Activities specifies 4 printed copies, Commission members and different Professional Team members will be attending. Please have available 7 printed copies of the presentations (printed two slides per page and duplexed),), 1 additional printed copy of the actuarial standards presentation (printed two slides per page and duplexed), and 8 printed copies of the Form A-6 graphical summaries, the color-coded contour map of the hurricane loss costs for strong owners frame buildings, and the scatter plot of the hurricane loss costs against distance to closest coast for strong owners frame buildings.

All documentation should be easily accessible from a central location in order to be reviewed electronically.

GENERAL HURRICANE STANDARDS
Mark Johnson, Leader

G-1 Scope of the Hurricane Model and Its Implementation*
*(*Significant Revision)*

A. The hurricane model shall project loss costs and probable maximum loss levels for damage to insured residential property from hurricane events.

B. A documented process shall be maintained to assure continual agreement and correct correspondence of databases, data files, and computer source code to presentation materials, scientific literature, technical literature, and modeling organization documents.

C. All software, data, and flowcharts (1) located within the hurricane model, (2) used to validate the hurricane model, (3) used to project modeled hurricane loss costs and hurricane probable maximum loss levels, and (4) used to create forms required by the Commission in the Hurricane Standards Report of Activities shall fall within the scope of the Computer/Information Hurricane Standards.

D. All meteorological forms, statistical Forms S-1, S-2, and S-6, and all actuarial forms with the exception of Form A-2 shall be produced through an automated procedure or procedures as indicated in the form instructions.

E. Vintage of data, code, scientific literature, and technical literature used shall be justifiable.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

1. G-1.2, page 17: Given the response to S-2.3, discuss how sea-surface temperature (SST) could be incorporated in the model.

   Discussed that the model under review does not make any climate adjustments.

   Discussed that the version of the model adapted to a climate with warmer SSTs than the long-term average model was discussed with the Commission during the September 2022 climatology planning workshop, and is not relevant to the model under review.

2. G-1.7.C, Figure 4, page 32: Compared to Figure 4 in the current accepted model submission, Figure 4 here appears to be approximately reversing the direction of change. For example, the I-4 Corridor (Tampa to Orlando up to Jacksonville) is strongly red whereas it was predominantly blue. Explain what is driving the change in Escambia and Santa Rosa Counties.

   Discussed that in the current accepted model, an increase in storm frequency in the Florida panhandle was due to the landfall of Hurricane Sally (2020). In the model under review, the addition of two seasons with no landfalls in the Florida panhandle resulted in a decrease in frequency in the panhandle.

3. G-1.7.C, Figure 4, page 32: Explain the decrease in Broward County relative to the increase in surrounding counties.

   Discussed that the increase in storm frequency in Miami-Dade and Palm Beach Counties is due to the landfalls of Hurricane Ian (2022) and Hurricane Nicole (2022), and that landfall frequency decreased in other areas due to two additional seasons with no landfalls in those areas.

4. G-1.7.C, Figure 4, page 32:
   a. Provide details for the reason for changes in annual zero deductible hurricane loss costs due to changes in event generation.
   b. Identify the specific updates in HURDAT2 that had an impact.
   c. Explain how the changes in event generation resulted in changes in loss costs of up to 25% across multiple counties.

   Discussed that the increase in loss costs is due to the increase in landfall intensity and frequency with the additions of Hurricane Ian (2022) and Hurricane Nicole (2022).

5. G-1.7.C, Figure 5, page 32: Explain the changes in the vulnerability component that led to substantially different loss costs (e.g., Sumter County).

   Discussed that the less than 1% increase in Sumter County loss costs is due to updates in the model age band structure. Reviewed the year-built data for Sumter County and the change in number of structures across age bands.

   Reviewed a table comparing the year-built data for Sumter, Hernando, and Lake Counties and the change in number of structures across age bands.

6. G-1.7.C, Figure 6, page 33: Justify the results in the figure for neighboring counties Pasco-Hillsborough and Gulf-Franklin.

   Discussed that a ZIP Code centroid movement from Hillsborough County to Pasco County with the majority of exposure estimated to be in Pasco County resulted in the loss cost changes.

Reviewed geographical image of the centroid change from Hillsborough to Pasco County.

Discussed that both Gulf and Franklin Counties were impacted by ZIP Code centroid changes. Gulf County decreased because the ZIP Code centroids moved further inland resulting in lower mean damage ratios while Franklin County increased due to the ZIP Code centroids moving closer to the coast resulting in higher mean damage ratios.

Reviewed geographical images of the centroid changes in Gulf and Franklin Counties.

Audit

1. Compliance with the requirements in Hurricane Standard G-1.B in all stages of the modeling process will be reviewed.

   Discussed the documented processes and best practices followed to ensure agreement of data and information across and within the modeling organization.

   Reviewed an example process and flowchart for updates to the ZIPAll database.

2. Maps, databases, and data files relevant to the submission will be reviewed in the course of the on-site review.

   All maps, databases, and data files were available for review. Reviewed samples throughout the audit.

3. Justification for the vintage of data, code, scientific literature, and technical literature used will be reviewed in the course of the on-site review.

   Discussed the justifications for the vintage of data, code, scientific literature, and technical literature under the relevant standards.

4. Supporting material for the hurricane model changes in Disclosure 7 will be reviewed.

   Reviewed the supporting material for the model updates to the event generation including the historical storm set and the stochastic catalog, building vulnerability, and ZIP Code data, and software enhancements to improve functionality.

   Reviewed the impact of the model updates on the average annual loss costs.

5. For any changes made in the hurricane model since the initial submission, color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide hurricane loss costs based on the 2017 FHCF exposure data for each hurricane model component change, between the initial submission and the revised submission, and between any intermediate revisions and the revised submission, will be reviewed.

   Discussed that there have been no changes to the hurricane model since the initial submission.

6. For any modifications to Form A-4 using the 2017 FHCF exposure data resulting from changes in the hurricane model since the initial submission, a newly completed Form A-5 with the initial submission as the baseline for computing the percentage changes, and with any intermediate revisions as the baseline for computing the percentage changes, will be reviewed.

   Discussed that there have been no changes to Form A-4 since the initial submission.

7. If the output ranges in Form A-4 using the 2023 FHCF exposure data are regenerated since the initial submission, a Form A-5 based on the output range percentage changes using the 2023 FHCF exposure data with the initial submission as the baseline for computing the percentage changes, and with any intermediate revisions as the baseline for computing the percentage changes, will be reviewed.

   Not applicable as the output ranges have not changed since the initial submission.

G-2 Qualifications of Modeling Organization Personnel and Consultants Engaged in Development and Implementation of the Hurricane Model*

*(*Significant Revision)*

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

B. The hurricane model and hurricane model submission documentation shall be reviewed by modeling organization personnel or consultants in the following professional disciplines with requisite experience: structural/wind engineering (current licensed professional engineer), statistics (advanced degree or equivalent experience), actuarial science (Associate or Fellow of Casualty Actuarial Society or Society of Actuaries), meteorology (advanced degree), and computer/information science (advanced degree or equivalent experience and certifications). These individuals shall certify Expert Certification Forms G-1 through G-6 as applicable.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

7. G-2.2.B, pages 37-54: Provide resumes of the new personnel.

Reviewed resumes of new personnel involved with the Verisk model:

- Paul Ericksen, B.A. in Mathematics, Princeton University, Princeton, NJ
- Nazanin Firouzbakht, M.B.A. in Marketing, Boston University, Boston, MA; B.S. in Industrial Engineering, Azad University, Tehran, Iran
- Lindsey Fletcher, B.S. in Mathematics and Industrial Engineering, Worcester Polytechnic Institute, Worcester, MA
- Evan McDonagh, B.S. in Business Information Systems, National University of Ireland, Galway, Ireland
- Anil Nakarikanti, B. Tech in Computer Science and Engineering, Jawaharlal Nehru Technological University, Hyderabad, India

- Glen Patashnick, M.S. in Actuarial Science, Boston University, Boston, MA; B.A. in Computer Science, Dartmouth College, Hanover, NH

- Anup Rajasekharan Nair, M.B.A. in Analytics, Alliance University, Anekal, India; B. Tech in Civil Engineering, Kannur University, Kannur, India

- Haripprikesh Srinivasan, B.S. in Electronics and Communication Engineering, Anna University, Chennai, India

- Yuanyuan Yang, M.S. in Data Science, Tufts University, Medford, MA; M.S. in Control Theory and Engineering, Tongji University, Shanghai, China; B.S. in Electrical Engineering, Tongji University, Shanghai, China

Audit

1. The professional vitae of new employees and consultants (since the previous submission) engaged in the development or implementation of the hurricane model under review and responsible for the submission will be reviewed.

   See PVL #7 for resumes reviewed.

2. Incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession will be discussed.

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

G-3 Insured Exposure Location*

*(*Significant Revision)*

A. ZIP Codes used in the hurricane model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the hurricane model. ZIP Code information shall originate from the United States Postal Service.

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

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

D. If any hurricane model components are dependent on ZIP Code databases, a logical process shall be maintained for ensuring these components are consistent with the recent ZIP Code database updates.

E. Geocoding methodology shall be justified.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. Geographic displays for all ZIP Codes will be reviewed.

   Reviewed geographic representation of ZIP Code boundaries and centroids.

2. Geographic comparisons of previous to current locations of ZIP Code centroids will be reviewed.

   Reviewed geographic comparisons of previous to current locations of ZIP Code centroids for the top 10 greatest distance centroid movements. Discussed large changes in centroids resulting from changing population centers in sparsely populated ZIP Codes.

   Reviewed comparison to the current accepted model of the population for the ZIP Code centroid movements that fall outside of the ZIP Code boundaries.

3. Third party vendor information, if applicable, and a complete description of the process used to validate ZIP Code information will be reviewed.

   Discussed the process for reviewing and validating ZIP Code data obtained from Claritas.

Discussed that census blocks were updated from the 2010 to the 2020 vintage.

4. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.

   Discussed that when a centroid falls over water or other uninhabitable terrain, the model does not treat it differently from other centroids and that the same methodology is applied to estimate loss for every ZIP Code centroid.

   Discussed that winds and losses are not over-estimated when ZIP Code centroids fall over water because the actual address, street, or latitude-longitude information is modeled, and that the ZIP Code centroid is only encountered at an aggregate data level.

5. Examples of geocoding for complete and incomplete street addresses will be reviewed.

   Discussed the process for geocoding user-provided street address information.

   Reviewed incomplete address examples.

6. Examples of latitude and longitude to ZIP Code conversions will be reviewed.

   Discussed the process to assign ZIP Codes to user-provided latitude-longitude information.

   Reviewed latitude-longitude to ZIP Code examples.

7. Hurricane model ZIP Code-based databases will be reviewed.

   Discussed that there was no change in how the ZIP Code databases are updated.

G-4 Independence of Hurricane Model Components

The meteorology, vulnerability, and actuarial components of the hurricane model shall each be theoretically sound without compensation for potential bias from other components.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. The hurricane model components will be reviewed for adequately portraying hurricane phenomena and effects (damage, hurricane loss costs, and hurricane probable maximum loss levels) in the course of the on-site review. Attention will be paid to an assessment of (1) the theoretical soundness of each component, (2) the basis of the integration of each component into the hurricane model, and (3) consistency between the results of one component and another.

   Reviewed the theoretical soundness, integration of components, and consistency across components throughout the audit.

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

2. All changes in the hurricane model since the previous submission that might impact the independence of the hurricane model components will be reviewed.

   Reviewed all changes in the hurricane model since the current accepted model and determined none of the model updates impacted the independence of each model component.

G-5 Editorial Compliance

The submission and any revisions provided to the Commission throughout the review process shall be reviewed and edited by a person or persons with experience in reviewing technical documents who shall certify on Form G-7 that the submission has been personally reviewed and is editorially correct.

Verified: **YES**

Professional Team comments are provided in black font below.

Audit

1. An assessment that the person who has reviewed the submission has experience in reviewing technical documentation and that such person is familiar with the submission requirements as set forth in the *Hurricane Standards Report of Activities as of November 1, 2023,* will be made.

   Discussed the experience of the editorial signatory, and the process she followed to review the submission document throughout the development process.

2. Attestation that the submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and no inclusion of extraneous data or materials will be assessed.

   Discussed the process followed to review the model submission throughout the development process by the different department teams and the editorial signatory, and review of the final submission document by the expert certification signatories.

3. Confirmation that the submission has been reviewed by the signatories on the Expert Certification Forms G-1 through G-6 for editorial compliance will be assessed.

   Verisk confirmed that subject matter experts reviewed all submitted materials for completeness and accuracy.

4. The modification history for submission documentation will be reviewed.

   Reviewed the submission documentation modification history.

5. A flowchart defining the process for form creation will be reviewed.

   Reviewed a flowchart defining the process for submission form creation using Touchstone.

Editorial items noted in the pre-visit letter and during the on-site review by the Professional Team were satisfactorily addressed during the audit. The Professional Team has reviewed the submission, but cannot guarantee that all editorial difficulties have been identified. The modeler is responsible for eliminating such errors.

METEOROLOGICAL HURRICANE STANDARDS
Mark Powell, Leader

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

A. The Model Base Hurricane Set shall be one of the following: (1) Reference Hurricane Set, (2) Model Adjusted Hurricane Set, or (3) Model Climate-Adjusted Hurricane Set, and shall be justifiable.

B. A climate-adjusted hurricane model shall use one of the hurricane sets listed in A as its Model Base Hurricane Set and shall be justifiable.

C. Annual frequencies used in the hurricane model validation shall be based upon the Model Base Hurricane Set.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. The Model Base Hurricane Set and its justification will be reviewed.

Discussed that the Model Base Hurricane Set is based on hurricanes from 1900-2022 in HURDAT2 as of April 7, 2023 supplemented by landfall data from National Weather Service (NWS) National Hurricane Center (NHC)-6 when needed.

Discussed that no climate change adjustments were made to the Model Base Hurricane Set.

Discussed the difference between the Model Base Hurricane Set and the annual occurrence landfall rates by Saffir-Simpson category in Form M-1. Discussed that central pressure is used in the model as the statistically modeled parameter determining simulated storm intensity.

Discussed that the modeled surface wind profile is a different interpretation from the NHC's Vmax. Discussed that the maximum modeled surface wind profile is generally lower.

Reviewed a scatter plot of the maximum modeled surface wind profile to NHC reported Vmax in HURDAT2 "L" rows.

2. A flowchart or other illustration of how changes in the Reference Hurricane Set are used in the calculation of the Model Base Hurricane Set landfall distribution will be reviewed.

   Reviewed a flowchart of the process for updating the Model Base Hurricane Set landfall distribution.

   Discussed how the Saffir-Simpson hurricane categories are determined for completing Form M-1.

3. Changes to the Model Base Hurricane Set from the current accepted hurricane model used will be reviewed.

   Discussed that Hurricanes Elsa (2021), Ian (2022), and Nicole (2022) were added to the Model Base Hurricane Set.

   Discussed that Hurricanes Alma (1966), Inez (1966), Abby (1968), and Gladys (1968) were modified.

4. Modeled probabilities will be compared with observed hurricane frequency using methods documented in current scientific literature and current technical literature. The goodness-of-fit of modeled to the Reference Hurricane Set statewide and regional hurricane frequencies as provided in Form M-1 will be reviewed.

   Reviewed landfall frequency goodness-of-fit Chi-square tests by region for Florida and neighboring states that were found to be satisfactory. Discussed regions where there were insufficient data to perform the Chi-square tests.

5. If the model is a climate-adjusted model, changes in hurricane intensity, frequency, and track, if applicable, will be reviewed.

   Discussed that the model is not climate-adjusted and that no climate modifications have been made to the historical annual hurricane frequencies, intensities, and tracks.

M-2 Hurricane Parameters (Inputs)*

*(*Significant Revision)*

Methods for depicting all modeled hurricane parameters shall be based on information documented in current scientific literature and current technical literature.

Verified: YES

Professional Team comments are provided in black font below.

Reviewed plots of the radial profile adjustment of the gradient wind reduction factor (GWRF) and the peak weighting factor (PWF).

Discussed the time variation in the GWRF and PWF profiles after landfall. Reviewed examples of the radial profile and profile changes with time after landfall.

Reviewed the calculation of the maximum and minimum surface wind given the gradient wind, asymmetry factor, GWRF, friction factor, gust factor, and wind averaging time.

During the April 3, 2025, virtual review, the modeling of hurricane surface winds, including the order of operations, was reviewed. Discussed the various variables in the surface wind calculations and how they are applied.

Discussed that the friction factor is applied to the total mean 1-minute 10-meter wind.

Reviewed the calculation of 1-minute average winds at 10-meter height. Reviewed the gust factor formulation based on Simiu and Scanlon, 1996.

Reviewed scatter plot validation of modeled winds with historical wind observations.

Reviewed Verisk's justification for the modeling approach.

See additional comments under M-4, Audit 4.

The Professional Team had disparate opinions regarding verification and will discuss the issue with the Commission during the trade secret session of the June 2025 meeting to review the model for acceptability.

Pre-Visit Letter

8. M-2.2, page 70: Discuss the time dependence of the meteorological parameters listed, given the responses to Standards G-1.2 (page 18) and M-2.6 (page 73).

   Discussed that the parameters listed relate to storm track, intensity, and structure.

   Discussed the procedure to describe the evolution of the storm track parameters.

   Discussed that central pressure follows a decay function, and that peripheral pressure is constant and selected at time of landfall.

   Discussed that Rmax is a function of central pressure and latitude, and that its time evolution depends on the two parameters.

   Discussed that the GWRF and the PWF are constant factors throughout the lifetime of the storm. Discussed that the application of the GWRF and PWF factors evolves with time after landfall.

Audit

1. Supporting material for the meteorological component changes in Disclosure 1 will be reviewed.

   Discussed that there were no modifications to the meteorological component since the current accepted model.

2. All hurricane parameters used in the hurricane model, including any adjusted for climate change, will be reviewed.

   Reviewed the hurricane parameters including intensity based on central pressure deficit, peripheral pressure adjustment, GWRF, PWF, Rmax, landfall location, forward speed, heading, and landfall frequency.

3. Graphical depictions of hurricane parameters as used in the hurricane model will be reviewed. Descriptions and justification of the following will be reviewed:

   a. The dataset basis for the fitted distributions, the methods used, and any smoothing techniques employed,

   Discussed that the correlation between central pressure and Rmax is incorporated using a regional regression model.

   Discussed that the correlation between GWRF and PWF is incorporated using a bivariate normal distribution.

Discussed that the maximum likelihood method is used for fitting whenever appropriate, and that smoothing methods are used when data is sparse for coastal segments.

b. The modeled dependencies among correlated parameters in the windfield component and how they are represented, and

Reviewed the relationship between GWRF and PWF.

Reviewed scatter plot comparison between modeled and observed GWRF versus PWF. Discussed the dropsonde data underlying the scatter plot. Discussed the data source for the mean GWRF values.

Discussed the air density coefficient dependence on latitude.

Reviewed the GWRF sampling distribution.

c. The parameters affecting asymmetric structure of hurricanes.

Reviewed the asymmetry factor calculation and parameters.

M-3 Hurricane Probability Distributions*

*(*Significant Revision)*

A. Modeled probability distributions of hurricane parameters shall be consistent with the Model Base Hurricane Set. Any differences shall be justifiable.

B. Modeled hurricane landfall frequency distributions shall reflect the Model Base Hurricane Set used for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi). Any differences shall be justifiable.

C. The hurricane model shall use maximum one-minute sustained 10-meter windspeed when defining hurricane landfall intensity. This applies both to the Model Base Hurricane Set used to develop landfall frequency distributions as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter windspeed shall be within the range of windspeeds (in statute miles per hour) categorized by the Saffir-Simpson Hurricane Wind Scale.

Verified: YES

Professional Team comments are provided in black font below.

Reviewed the regression equation for GWRF and input of HURDAT2 data.

Reviewed a requested revision to the text under M-3.A to clarify the Verisk definition of intensity in the model.

Audit

1. The statistical goodness-of-fit extending beyond the Florida border will be reviewed by evaluating results for appropriate coastal segments in Alabama, Georgia, and Mississippi.

   Reviewed the goodness-of-fit results for Alabama, Georgia, and Mississippi under M-1, Audit 4.

2. The method and supporting material for selecting stochastic storm tracks will be reviewed.

   Reviewed the methodology for selecting stochastic storm tracks.

   Reviewed a statistical comparison of historical to stochastic storms making multiple Florida landfalls.

3. The method and supporting material for selecting storm track landfall statistics will be reviewed. If landfall positions are on a discrete set, the hurricane landfall points for major metropolitan areas in Florida will be reviewed.

   Discussed that landfall locations are selected from a continuous uniform distribution within each 50-mile coastal segment.

4. Any modeling-organization-specific research performed to develop the functions used for simulating hurricane model variables or to develop databases will be reviewed.

   Reviewed the published scientific literature used for simulating hurricane model variables.

   Reviewed internal research on the GWRF and stepped frequency microwave radiometer (SFMR) data.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

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

B. The land use and land cover (LULC) database shall be consistent with National Land Cover Database (NLCD) 2016 or later. Use of alternate datasets shall be justified.

C. The translation of land use and land cover or other source information into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.

D. With respect to multi-story buildings, the hurricane model shall account for the effects of the vertical variation of winds.

Verified: YES

Professional Team comments are provided in black font below.

Discussed the Willoughby wind profile and its application as a 10-minute wind consistent with the treatment of adjusted winds in the NWS-23 report.

Audit

1. Any modeling-organization-specific research performed to develop the windfield functions used in the hurricane model will be reviewed. The databases used will be reviewed.

   Discussed the databases and research conducted to develop the windfield functions.

2. Any modeling-organization-specific research performed to derive the roughness distributions for Florida and neighboring states will be reviewed.

   Discussed that the roughness distribution for Florida was primarily derived from published literature with a blending of Verisk expertise.

   Discussed that high resolution wind measurements from Texas Tech University were used to identify turbulence intensity as a function of wind direction.

3. The spatial distribution of surface roughness used in the hurricane model will be reviewed.

   Reviewed geographical representation of the model surface roughness distribution for Florida which has not changed from the current accepted model.

4. A flowchart or other illustration depicting the process for calculating hurricane surface winds will be reviewed.

   Reviewed the surface winds calculation flowchart. Discussed the order of operations for calculating hurricane surface winds. Reviewed an example of wind adjustments after altering the order of operations which revealed higher winds in the reordered implementation.

   Reviewed comparison of modeled to observed hurricane surface winds implemented in the model and implementation after altering the order of operations. The altered methodology relative to observation data showed a higher root mean square error (RMSE) and bias than with the current implementation in the model. The analysis included over 1,903 observations across 39 storms.

   Reviewed the friction factor formulation. Reviewed an example of the friction factor application at a location in the western Florida Panhandle.

5. The previous and current hurricane parameters used in calculating the hurricane loss costs for the LaborDay03 (1935) and NoName09 (1945) hurricane landfalls will be reviewed. Justification for the choices used will be reviewed. The resulting spatial distribution of winds will be reviewed with Form A-2.

   Reviewed maps of the spatial distribution of winds for the LaborDay03 (1935) and NoName09 (1945) storms.

6. For windfields not previously reviewed, detailed comparisons of the hurricane model windfield with Hurricane Charley (2004), Hurricane Wilma (2005), Hurricane Irma (2017), and Hurricane Michael (2018) will be reviewed.

   Discussed that there was no change in the model windfield, and that the windfields in the audit item have been previously reviewed.

7. Representation of vertical variation of winds in the hurricane model, where applicable, will be reviewed.

   Discussed that the development of friction and gust factors assume boundary layer winds follow the log-law. Discussed that the scientific basis of the log-law applies to mean wind profiles. Discussed additional scientific research that challenges the applicability of log-law in the context of hurricane boundary layer. Reviewed graphical illustration.

   Discussed that the vertical variations of winds are accounted for through the vulnerability functions.

8. Description of and justification for the value(s) of the far-field pressure used in the hurricane model will be reviewed.

   Discussed that modeled peripheral pressure increases with latitude, and is consistent with Knaff and Zehr (2007).

9. The treatment of the inherent uncertainty in the conversion factors used to convert the modeled winds to surface winds will be reviewed and compared with current scientific literature and current technical literature. Treatment of conversion factor uncertainty at a fixed time and location within the windfield for a given hurricane intensity will be reviewed.

   Discussed that the mean GWRF and the standard deviation are within the range of published research given in Powell et al. (2009) and Franklin et al. (2003).

   Discussed that the uncertainty is modeled using the referenced standard deviation value.

   Discussed that the GWRF uncertainty is defined at time of landfall and applied uniformly throughout the life of the simulated storm.

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

    Reviewed external data sources relevant to the model windfields.

M-5 Hurricane Intensity Change Methodologies*

*(*Significant Revision)*

A. The hurricane intensity change methodology used by the hurricane model shall be consistent with current state-of-the-science.

B. The transition of winds from over water to over land within the hurricane model shall be consistent with current state-of-the-science.

C. Intensity change of hurricanes that pass from over land to over water shall be consistent with current state-of-the-science.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. The variation in overland decay rates used in the hurricane model will be reviewed.

   Discussed that the decay rates vary by geographic area and by storm intensity at landfall.

   Reviewed the over-land decay function calculation.

   Reviewed the overland decay parameters.

2. The transition of storm intensity from over land to over water will be reviewed.

   Discussed that the model allows for either re-intensification or continued decay once a storm is back over water.

   Discussed the methodology for re-intensification of hurricanes over water with multiple landfalls.

3. Comparisons of the hurricane model weakening rates to weakening rates for historical Florida hurricanes will be reviewed.

   Reviewed comparisons between observed and modeled increases in minimum central pressure over land for Hurricanes Earl (1998), Frances (2004), Jeanne (2004), and Dennis (2005).

   Reviewed additional examples of weakening rates of modeled versus observed landfalling hurricanes in the western Florida Panhandle.

4. The detailed transition of winds from over water to over land (i.e., hurricane landfall, boundary layer) will be reviewed. The region within 5 miles of the coast will be emphasized. Color-coded snapshot maps of roughness length and spatial distribution of over land and over water windspeeds for Hurricane Charley (2004), Hurricane Michael (2018), and Hurricane Ian (2022) at the closest time after landfall will be reviewed.

   Reviewed instantaneous maps of surface roughness length and windspeed at landfall for Hurricanes Charley (2004), Michael (2018), and Ian (2022).

   Reviewed examples of a transition from the fixed marine roughness to open terrain and a windspeed dependent roughness to open terrain.

   Discussed the friction factor and validation examples for points along the coast.

M-6 Logical Relationships of Hurricane Characteristics*

*(*Significant Revision)*

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

B. The mean windspeed shall decrease with increasing surface roughness (friction), all other factors held constant.

Verified: YES

Professional Team comments are provided in black font below.

Reviewed Form M-3. Discussed that quartiles are computed from the distributions of modeled Rmax and significant wind radii. Discussed that sample sizes for Rmax and radius >110mph are different since storms with a central pressure of 960-980 do not reach 110mph while all the storms have a Rmax.

Audit

1. The logical relationship between windspeed and surface roughness will be reviewed.

   Discussed that surface roughness length values are mapped uniquely to the LULC categories.

   Reviewed the shape of the upstream weighting factor. Discussed that the weighting function to compute the physical properties factors was calibrated using observational data to ensure unbiased winds.

2. Justification for the relationship between intensity and radius of maximum winds will be reviewed.

   Reviewed the relationship between modeled Rmax to historical central pressure. Discussed the lowest modeled Rmax value.

3. The mathematical dependence of the modeled windfield as a function of distance and direction from the center position will be reviewed.

   Reviewed the equations for modeled windspeed based on the Willoughby et al. (2006) radial wind profile model.

4. Justification for the variation of the asymmetry with the translation speed will be reviewed.

   Discussed that there has been no change in the asymmetry methodology from the current accepted model.

5. Methods (including any software) used in verifying logical relationships of hurricane characteristics will be reviewed.

   Discussed the methodology used for verifying logical relationships between stochastic parameters.

   Reviewed an example of the central pressure and Rmax relationship verifying a positive correlation.

6. Contour animations of windfield distributions demonstrating scientifically reasonable windfield characteristics and logical relationships will be reviewed.

   Reviewed a contour animation of the windfield distribution for Hurricane Frances (2004) evolving from pre-landfall through final landfall.

STATISTICAL HURRICANE STANDARDS
Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit*
*(*Significant Revision)*

A. The use of historical data in developing the hurricane model shall be supported by rigorous methods published in current scientific literature and current technical literature.

B. Modeled results shall reflect statistical agreement with historical data or the Model Base Hurricane Set using current scientific and statistical methods for the academic disciplines appropriate for the various hurricane model components. Any differences shall be justifiable.

Verified: YES

Professional Team comments are provided in black font below.

Discussed that the addition of Hurricane Ian (2022) and Hurricane Nicole (2022) to the Model Base Hurricane Set led to significant differences in the distributions for some landfall segments. This led to refitting distributions of the primary hazard features from Form S-3, and then adding and removing storms from the stochastic catalog as appropriate.

Reviewed the updated fits for landfall frequency, intensity, and location. Reviewed comparison of the probability distribution by coastal segment between the current accepted model and the model under review.

Discussed the Anderson-Darling goodness-of-fit test using Braun's adjustment for the stochastic hurricane parameter for landfalling calendar date described in S-1.8.

Pre-Visit Letter

9. S-1.5, Figure 21, page 97: Explain the change from the current accepted model in Central Pressure Distribution by Saffir-Simpson Category (most notably Category 1) while the cumulative distribution of central pressure looks unchanged.

   Discussed that Hurricane Ian (2022) and Hurricane Nicole (2022) were added to the Model Base Hurricane Set.

   Reviewed modeled distribution of frequency comparisons to the current accepted model showing an increase in Category 3+ and a decrease in Category 1 storms.

10. S-5.1, Table 4, pages 109-110: Many of the modeled losses differ significantly from the actual losses. For example, Hurricane Ivan (2004) with Company I (approximately $6 million versus $48 million). Justify the level of disagreement throughout this table.

    Reviewed the unscaled losses from Hurricane Ivan (2004).

    Discussed the sources of the differences between modeled and actual losses.

Audit

1. The modeling organization characterization of uncertainty for windspeed, damage estimates, annual hurricane loss, hurricane probable maximum loss levels, and hurricane loss costs will be reviewed in the course of the on-site review.

    Discussed that uncertainty related to damage estimates are covered in the Vulnerability Standards.

    Discussed that the gradient wind reduction factor (GWRF) contributes the most to loss cost uncertainty with pressure-related variables contributing for weaker storms.

2. Regression analyses performed will be reviewed, including parameter estimation, graphical summaries and numerical measures of the quality of fit, residual analysis and verification of regression assumptions, outlier treatment, and associated uncertainty assessment.

    Reviewed the Rmax regression model and verification of the regression assumptions.

    Discussed that modeled Rmax follows a truncated normal distribution, with mean depending on central pressure and latitude, and variance and upper and lower bounds on central pressure.

    Reviewed the relationship between central pressure and latitude, QQ plot of residuals versus theoretical quantiles, and the residuals versus fitted values.

    Reviewed the Rmax quality of fit and uncertainty assessment.

S-2 Sensitivity Analysis for Hurricane Model Output*

*(*Significant Revision)*

The modeling organization shall have assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables using current scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action.

Verified: YES

Professional Team comments are provided in black font below.

No changes were made in model methodology from the current accepted model, and no new sensitivity analyses were performed.

S-3 Uncertainty Analysis for Hurricane Model Output*

*(*Significant Revision)*

The modeling organization shall have performed an uncertainty analysis on the temporal and spatial outputs of the hurricane model using current scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action. The analysis shall identify and quantify the extent that input variables impact the uncertainty in hurricane model output as the input variables are simultaneously varied.

Verified: YES

Professional Team comments are provided in black font below.

No changes were made in model methodology from the current accepted model, and no new uncertainty analyses were performed.

S-4 County Level Aggregation

At the county level of aggregation, the contribution to the error in hurricane loss cost estimates attributable to the sampling process shall be negligible.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. The accuracy associated with Nassau County will be reviewed. The contribution of simulation uncertainty via confidence intervals will be reviewed.

   Reviewed the standard error in Nassau County as a percentage of hurricane loss costs over various years of simulation.

   Reviewed comparison of average annual loss between a 50,000-year sample and a 100,000-year sample for different lines of business.

   Discussed the reason for the exposure change for Hurricane Charley (2004) in Table 39 from the current accepted model while other storms in the table had no changes in exposure.

S-5 Replication of Known Hurricane Losses*

*(*Significant Revision)*

The hurricane model shall estimate incurred hurricane losses in an unbiased manner on a sufficient body of past hurricane events from more than one company, including the most current data available to the modeling organization. This standard applies separately to personal residential and, to the extent data are available, to commercial residential. Personal residential hurricane loss experience may be used to replicate structure-only and contents-only hurricane losses. The replications shall be produced on an objective body of hurricane loss data by county or an appropriate level of geographic detail and shall include hurricane loss data from Hurricane Irma (2017), Hurricane Michael (2018), and Hurricane Ian (2022) to the extent data from Hurricane Ian are available.

Verified: YES

Professional Team comments are provided in black font below.

Reviewed the analysis completed on Hurricane Irma (2017) and Hurricane Michael (2018) claims data from Property Claim Services (PCS). Discussed that only the industry reported aggregated losses were available from PCS by County.

Reviewed comparisons of PCS residential reported losses to modeled losses for both storms.

Discussed that Hurricane Irma (2017) claims data is only being used in the development of a future model.

Audit

1. The following information for each insurance company and hurricane will be reviewed:

   a. The validity of the hurricane model assessed by comparing projected hurricane losses produced by the hurricane model to actual observed hurricane losses incurred by insurers at both the state and county level,

   Reviewed the comparisons of modeled and actual losses provided in revised Forms S-4 and S-5. Discussed that the wrong historical storm set was used to generate the initial submission forms.

   b. The version of the hurricane model used to calculate modeled hurricane losses for each hurricane provided,

   Discussed that the Verisk Hurricane Model for the U.S. Version 3.0.0 as implemented in Touchstone 2024A was used to generate all modeled historical losses.

c. A general description of the data and its source,

Discussed that the data used for validation consists of both exposures and actual claim data from several client companies for several historical hurricane events.

d. A disclosure of any material mismatch of exposure and hurricane loss data problems, or other material consideration,

Discussed that there are no identified mismatches or data problems.

e. The date of the exposures used for modeling and the date of the hurricane,

Discussed that the exposure used for modeling is the in-force book from each insurance company at the time of the hurricane.

f. An explanation of differences in the actual and modeled hurricane parameters,

Discussed that the track and central pressure hurricane parameters reported in HURDAT2 are used without modification.

g. A list of the departures, if any, in the windfield applied to a particular hurricane for the purpose of validation and the windfield used in the hurricane model under review,

Discussed that no changes are made to historical hurricane parameters or the windfield model for loss validation.

h. The type of coverage applied in each hurricane to address:
   1. Personal versus commercial
   2. Residential structures
   3. Manufactured homes
   4. Commercial residential
   5. Condominiums
   6. Structures only
   7. Contents only
   8. Time element,

Discussed that the exposures provided by insurance companies for each hurricane reflect the policy coverage terms in effect at the time of the event, and that no modifications are made when modeling the exposures.

i. The treatment of demand surge or loss adjustment expenses in the actual hurricane losses or the modeled hurricane losses, and

Discussed that modeled losses include Verisk's view of demand surge to the hurricane events, and that insurance company claims data captures the impact of demand surge.

Discussed that loss adjustment expense (LAE) is not modeled, and that the claims data used for loss validation excludes LAE.

j. The treatment of flood losses (including hurricane storm surge losses) in the actual hurricane losses or the modeled hurricane losses.

Discussed the process used to account for storm surge losses being paid under a wind policy for residential properties, and how the process is applied to modeled losses used in loss validation.

Reviewed the analysis on the default leakage factor of storm surge losses paid in wind losses.

2. The following will be reviewed:

a. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),

Discussed that claims data that are still under review by the insurance company which provided the data or are restricted due to nondisclosure agreements are excluded from validation.

b. An analysis that identifies and explains anomalies observed in the validation data, and

Discussed the loss validation procedures involving comparison of modeled losses and actual losses across several historical events and lines of business to ensure there is no bias in validation. Discussed the data elements that could lead to biases.

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

Reviewed the "Project Information and Assumption Form (PIAF)" for processing the FHCF exposure data.

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

Discussed the 95% confidence interval on the difference between the mean historical and modeled losses provided in corrected Form S-5.

Discussed that the standard deviation and width of confidence intervals in Form S-5 are related to the historical dataset.

4. An additional version of Form S-4 with actual (i.e., non-disguised and non-scaled) values with associated scatter plots (modeled hurricane loss versus company actual hurricane loss) will be reviewed.

   Reviewed a corrected version of Form S-4 and scatter plots with unscaled values.

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

   Reviewed the results provided in corrected Form S-4 and S-5.1.

S-6 Comparison of Projected Hurricane Loss Costs*

*(*Significant Revision)*

The difference, due to uncertainty, between historical and modeled annual average statewide hurricane loss costs shall be reasonable, given the body of data, by established statistical expectations and norms.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. Justification for the following will be reviewed:

   a. Meteorological parameters,

   Meteorological parameters were reviewed under the Meteorological Standards.

   b. The effect of by-passing hurricanes,

   Reviewed map of the percentage of modeled loss costs by county attributable to by-passing stochastic hurricanes.

   Reviewed map of historical Florida by-passing hurricane tracks.

   c. The effect of actual hurricanes that had two landfalls impacting Florida,

   Reviewed map of the percentage of modeled loss costs by county attributable to stochastic hurricanes with two Florida landfalls.

   Reviewed map of historical hurricane tracks with multiple Florida landfalls.

   d. The departures, if any, from the windfield, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the hurricane model under review, and

   Discussed that there are no departures.

   e. Exposure assumptions.

   Discussed the exposure assumptions included in the PIAF.

VULNERABILITY HURRICANE STANDARDS
Masoud Zadeh, Leader

V-1 Development of Building Hurricane Vulnerability Functions*
*(*Significant Revision)*

A. Development of the building hurricane vulnerability functions shall be based on a combination of available insurance company hurricane claims data and rational engineering analysis supported by laboratory testing, field testing, or post-event site investigations.

B. The development of the building hurricane vulnerability functions and the treatment of associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.

C. Residential building stock classification shall be representative of Florida construction for personal and commercial residential buildings.

D. Building height/number of stories, primary construction material, year of construction, location, building code, and other construction characteristics, as applicable, shall be used in the development and application of building hurricane vulnerability functions.

E. Hurricane vulnerability functions shall be developed for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures.

F. The minimum windspeed that generates damage shall be consistent with fundamental engineering principles.

G. Building hurricane vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Building hurricane vulnerability functions shall not include explicit damage to the building due to flood (including hurricane storm surge and wave action).

Verified: YES

Professional Team comments are provided in black font below.

Discussed the square footage for selection of different vulnerability functions.

Discussed with Dr. Carol Friedland, an external reviewer and Vulnerability Standards signatory, her review of the model for compliance with the Vulnerability Standards, updates to the vulnerability component, and the vulnerability portion of the submission document.

Reviewed a Figure 29 flowchart revised during the review to reflect building, contents, and time element vulnerability function development.

Pre-Visit Letter

11. V-1.1, page 119: Provide further details on the changes.

Reviewed the change in vulnerability adjustment for unknown year built based on state-wide age distribution statistics. Reviewed a comparison to the current accepted model across year-built bands.

Reviewed the change in vulnerability adjustments to account for structural aging, building technology changes, and the aging and deterioration of roofs. Reviewed the assumptions made for aging.

Reviewed the update to the roof year built secondary risk feature which defaults the roof age to a new roof for structures built within the last 10 years. Reviewed comparison to the current accepted model of the updated roof year-built assignments.

Reviewed vulnerability functions for a one-story wood frame building with different roof replacement years.

12. V-1.4, page 123: Provide the recent hurricanes claims data, the results of the analyses, and how the analyses of the data have impacted the vulnerability component.

Discussed that industry insured loss estimates for Property and Claim Services (PCS) were obtained for Hurricane Ian (2022) and Hurricane Nicole (2022).

Discussed that Hurricane Ian (2022) industry insured loss estimates were available at the county level by line of business.

Discussed that no new insurance company claims data for Hurricane Ian (2022) and Hurricane Nicole (2022) were incorporated in the model.

Reviewed a summary of PCS industry insured losses for Hurricane Ian (2022) and Hurricane Nicole (2022) in Florida by line of business.

Discussed that the analyses of the industry insured losses from PCS had no impact on the vulnerability component of the model.

Reviewed comparison of modeled and PCS reported residential losses from Hurricane Ian (2022).

Reviewed comparison of modeled and PCS reported losses from Hurricane Ian (2022) for all lines in several Florida counties.

Discussed that there was not any new claims data at the location level.

13. V-1.8, pages 125-127: Explain and justify how vulnerability regions address U.S. Department of Housing and Urban Development (HUD) wind zones in Florida.

    Reviewed the regional and temporal variation in vulnerability of manufactured homes due to HUD standards.

14. V-1.10, pages 127-128: Discuss the consistency of the building and appurtenant structure hurricane vulnerability functions with insurance company hurricane claims data.

    Discussed that the vulnerability functions for building and appurtenant structures are derived from the same source.

    Discussed the fundamental reasons for consistency in the vulnerability functions for primary building and appurtenant structures.

15. V-1.11, pages 128-129:
    a. Explain how the weights are derived, updated, and applied.

    Discussed that unknown construction curves are derived as a weighted average of the vulnerability curves with known construction classes. The weights of each construction class are derived from Verisk's proprietary industry exposure database (IED).

    Reviewed the mean damage ratio (MDR) curves for unknown construction.

    b. Provide a detailed description of Verisk's industry exposure database, how often it is updated, and what is the basis for the updates.

    Discussed that the IED is updated annually to reflect current replacement values with the frequent change in material costs. Discussed the frequency of other updates to the IED.

16. Form V-1, pages 259-260: Explain the changes relative to the current accepted model in Part A and Part B.

    Discussed the submission editorial error notification to the Commission on March 18, 2025, involving Form V-1 of the current accepted model. Discussed the reason for the error and why the error was not detected during final review of the submission.

    Reviewed the corrected values in Form V-1 for the current accepted model provided on March 18, 2025.

    Discussed that there are no differences in the vulnerability functions used to complete Form V-1, and that the reference structure and process are identical to the current accepted model.

Reviewed a comparison of the Part B values in the corrected Form V-1 for the current accepted model and Form V-1 under review.

Discussed an error in Form V-1 discovered during the on-site review, the reason for the error, and a corrected form. Reviewed the changes from the current accepted model in the corrected Form V-1 values.

Audit

1. Supporting material for the building vulnerability component changes in Disclosure 1 will be reviewed.

   See PVL #11.

2. Comparisons of the modified building hurricane vulnerability functions with the current accepted hurricane model will be reviewed.

   Discussed that there are no fundamental changes to the base vulnerability functions from the current accepted model.

3. The breakdown of insurance company exposure data used to develop the building hurricane vulnerability functions into number of insurers, number of policies, number of locations, and amount of dollar exposure by policy type will be reviewed.

Policy Type	Number of Insurers	Number of Policies	Number of Locations	Exposure Value ($)
Personal Residential				
Manufactured Homes				
Commercial Residential				

Reviewed the requested breakdown of insurance company exposure data.

4. The breakdown of insurance company hurricane claims data used to develop the building hurricane vulnerability functions into events (year and storm name), number of insurers, number of policies, number of locations, number of claims, and amount of loss separated by policy type will be reviewed.

Year	Storm Name	Number of Insurers			Number of Policies			Number of Locations			Number of Claims			Loss Amount ($)		
		Personal Residential	Manufactured Homes	Commercial Residential	Personal Residential	Manufactured Homes	Commercial Residential	Personal Residential	Manufactured Homes	Commercial Residential	Personal Residential	Manufactured Homes	Commercial Residential	Personal Residential	Manufactured Homes	Commercial Residential

Reviewed the requested breakdown of insurance company hurricane claims data.

5. The modeling of uncertainty associated with building hurricane vulnerability functions for wood frame, masonry, and manufactured homes construction classes will be reviewed.

Discussed that the modeling of uncertainty associated with building hurricane vulnerability functions is a function of mean damage ratios.

Reviewed the secondary uncertainty distributions around various mean damage ratios and the coefficient of variation.

6. How the uncertainties in windspeed for an individual hurricane at a given location are accounted for in the hurricane model damage estimates will be reviewed.

Discussed that the uncertainty distributions around the MDR in the vulnerability functions is a combination of uncertainties in the wind hazard and the building performance as given in V-1.6.

Discussed that a significant portion of the uncertainty in damage at a given location can be attributed to the uncertainty in windspeed at the location.

7. Insurance company hurricane claims data in the original form will be reviewed with explanations for any changes made and descriptions of how missing or incorrect data were handled.

   Insurance company claims data was available for review.

8. The goodness-of-fit of the building hurricane vulnerability functions will be reviewed.

   Reviewed a scatter plot of modeled to claims MDRs.

   Reviewed the goodness-of-fit tests of the data to the fitted models using R.

9. Complete reports detailing loading conditions and damage states for any laboratory or field-testing data used will be reviewed.

   Reviewed an example report.

10. Rational engineering analysis used to develop building hurricane vulnerability functions will be reviewed for a variety of different building construction classes.

    Discussed the methodology for developing building hurricane vulnerability functions.

    Discussed that the framework has been peer reviewed by wind engineering experts for engineering soundness and rational engineering principals.

11. The combination of available insurance company hurricane claims data and rational engineering analysis to develop the building hurricane vulnerability functions will be reviewed.

    Discussed that claims data are used to validate and calibrate building vulnerability functions.

    Discussed when the Individual Risk Module data was last updated.

12. Laboratory or field tests and original post-event site investigation reports will be reviewed.

    Reviewed a post-site investigation report with damage pictures from Hurricane Milton (2024) and Hurricane Helene (2024).

13. Justification for the construction classes and characteristics used will be reviewed.

    Discussed the basis for the different construction types.

    Discussed that building vulnerability varies by height. Reviewed the different height categories in the model.

Discussed the use of year built to capture time variations due to the evolution of building codes and wind load standards, including their adoption and enforcement.

14. Multiple samples of building hurricane vulnerability functions for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures will be reviewed.

Reviewed samples of building vulnerability functions.

Reviewed vulnerability functions for one-story wood frame buildings with different square footage.

15. Documentation and justification for the effects on the building hurricane vulnerability functions due to applicable building codes will be reviewed.

Discussed that the model captures spatial and temporal variation in vulnerability due to the evolution of building codes and wind load standards, along with their adoption and enforcement.

Discussed the peer-reviewed study completed to understand the large number of building codes and standards.

Discussed that the Florida Building Code (FBC) year-built bands have not changed from the current accepted model.

Reviewed a map of the 11 regions in Florida based on windspeed, terrain exposure category, and the requirements of the wind borne-debris region (WBDR) and the high velocity hurricane zone (HVHZ).

Reviewed a table summarizing building assumptions for FBC 2010 compliant construction.

16. The process for incorporating new insurance company hurricane claims data, if any, will be reviewed.

Reviewed a flowchart for processing insurance company claims data.

17. How the claim practices of insurance companies are accounted for when insurance company hurricane claims data are used to develop building hurricane vulnerability functions will be reviewed. The level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, the impact of public adjusting, and the impact of the legal environment in the claims data analyses will be reviewed.

Discussed that any claims data excluded or adjusted for model validation is documented in the PIAF.

Discussed that legal impacts are not explicitly modeled, and that legal losses are excluded in vulnerability function development.

Discussed that the model implicitly accounts for legal costs to the extent that the costs are captured in claims data.

18. The percentage of damage at or above which the hurricane model assumes a total building loss will be reviewed.

Discussed that the model does not assume a total loss threshold, but rather a mean damage ratio based on the intensity of the event at the location of the structure.

19. The treatment of law and ordinance in building hurricane vulnerability functions will be reviewed.

Discussed that law and ordinance costs are not explicitly modeled in the vulnerability functions.

Discussed that the model implicitly accounts for additional law and ordinance costs to the extent that the costs are captured in claims data.

20. A plot comparing hurricane vulnerability functions for wood frame building structure, masonry building structure, and appurtenant structure will be reviewed.

Reviewed sample vulnerability functions.

21. A plot comparing appurtenant structure hurricane vulnerability functions with insurance company hurricane claims data will be reviewed.

Reviewed scatter plot comparison of building and appurtenant structure mean damage ratios.

Discussed that claims data include appurtenant structure losses with the building losses giving justification for combining building and appurtenant structure losses for validation.

V-2 Development of Contents Hurricane Vulnerability Functions*

*(*Significant Revision)*

A. Development of the contents hurricane vulnerability functions shall be based on a combination of available insurance company hurricane claims data and rational engineering analysis supported by laboratory testing, field testing, or post-event site investigations.

B. The relationship between the hurricane model building and contents hurricane vulnerability functions shall be consistent with, and supported by, the relationship observed in insurance company hurricane claims data.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

17. V-2.7, page 133: Explain how the relationship between contents and building damage functions capture the situation when there is minor damage to a building, such as a broken window, or a small roof damage that causes significant water damage to the contents.

    Discussed that vulnerability functions are predominantly derived from published research, engineering expertise, and damage surveys that are calibrated based on actual claims experience. Discussed that claims typically lack a detailed breakdown of the cause of loss other than identifying wind versus flood.

    Discussed that the model implicitly accounts for a higher content to physical damage relationship.

Audit

1. Supporting material for the contents vulnerability component changes in Disclosure 1 will be reviewed.

    Discussed that there were no changes or modifications to the methodology for calculating contents losses from the current accepted model.

2. Comparisons of the modified contents hurricane vulnerability functions, if any, with the current accepted hurricane model will be reviewed.

    Discussed that the contents vulnerability functions are the same as in the current accepted model.

3. Justification for changes from the current accepted hurricane model in the relativities between hurricane vulnerability functions for building and the corresponding hurricane vulnerability functions for contents will be reviewed.

   Not applicable since no modifications or changes were made to the contents vulnerability functions.

4. Multiple samples of contents hurricane vulnerability functions will be reviewed.

   Reviewed samples of contents vulnerability functions.

5. The goodness-of-fit of the contents hurricane vulnerability functions will be reviewed.

   Reviewed a scatter plot of modeled to actual contents MDRs.

6. The modeling of uncertainty associated with contents hurricane vulnerability functions for wood frame, masonry, and manufactured homes construction classes will be reviewed.

   Discussed that uncertainties for contents vulnerability functions are treated similar to building coverage.

   Reviewed sample contents secondary distributions for 10% and 20% contents mean damage ratios.

   Reviewed scatter plots of actual and modeled contents damage ratios versus windspeed for masonry construction and for single family homes.

7. Justification and documentation for the dependence of contents hurricane vulnerability functions on construction or occupancy type will be reviewed.

   Reviewed damage to contents due to infiltration of wind driven rain through roofs and damaged windows or fenestration.

   Discussed that intrusion of precipitation is directly dependent on structure damage, and that structure damage is dependent on construction, making contents damage dependent on the construction type.

8. Justification and documentation of the method of development, the underlying data, and assumptions related to contents hurricane vulnerability functions will be reviewed.

   Discussed that contents vulnerability functions are derived based on the relationship to the primary building damage, and the relationship is calibrated based on claims data.

9. Support for the rational engineering analysis used in developing the contents hurricane vulnerability functions will be reviewed.

   Discussed that the relationship between exterior damage and contents damage is an empirically derived function that is calibrated based on claims data, and is a rational approach given uncertainties in interior damage and insurance payout practices.

10. The combination of available insurance company hurricane claims data and rational engineering analysis to develop the contents hurricane vulnerability functions will be reviewed.

    Reviewed the process for contents vulnerability function development and calibration based on claims data.

    Reviewed the flowchart for derivation and implementation of the contents vulnerability functions.

11. The modeling of water infiltration on contents vulnerability functions for a multi-story commercial residential building, if applicable, will be reviewed.

    Discussed that the relationship of wind driven precipitation and water ingress, which is a function of exterior damage, is implicitly included to the extent the losses are included in the claims data used for calibration.

V-3 Development of Time Element Hurricane Vulnerability Functions*

*(*Significant Revision)*

A. Development of the time element hurricane vulnerability functions shall be based on a combination of available insurance company hurricane claims data and rational engineering analysis supported by laboratory testing, field testing, or post-event site investigations.

B. The relationship between the hurricane model building and time element hurricane vulnerability functions shall be consistent with, and supported by, the relationship observed in insurance company hurricane claims data.

C. Time element hurricane vulnerability function development shall consider the estimated time required to repair or replace the property.

D. Time element hurricane vulnerability functions shall include time element hurricane losses associated with damage to the infrastructure caused by a hurricane.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. Supporting material for the time element vulnerability component changes in Disclosure 1 will be reviewed.

   Discussed that there have been no changes to the vulnerability methodology for calculating time element losses from the current accepted model.

   Discussed that relativities between structure loss and time element loss remain the same.

2. Comparisons of the modified time element hurricane vulnerability functions, if any, with the current accepted hurricane model will be reviewed.

   Not applicable since no changes were made to the time element vulnerability functions.

3. Justification for changes from the current accepted hurricane model in the relativities between hurricane vulnerability functions for building and the corresponding hurricane vulnerability functions for time element will be reviewed.

   Not applicable since no changes were made to the time element vulnerability functions.

4. Multiple samples of time element hurricane vulnerability functions will be reviewed.

   Reviewed examples of the time element vulnerability functions.

5. The modeling of uncertainty associated with time element hurricane vulnerability functions for wood frame, masonry, and manufactured home construction classes will be reviewed.

   Discussed the time element to building damage relationship.

   Discussed that uncertainties are treated similar to building coverage with a secondary probability distribution around the mean.

   Reviewed the secondary distribution for time element around a mean downtime of 3 days.

   Reviewed the relationship of time element MDR to building MDR for historical and modeled results.

6. Justification and documentation of the method of development, the underlying data, and assumptions related to time element hurricane vulnerability functions will be reviewed.

   Discussed that the time element vulnerability relationships are engineering based estimates of the time to repair for different building damage levels and are validated with claims data from historical storms.

   Reviewed an example time element vulnerability function for a residential building.

7. The goodness-of-fit of the time element vulnerability functions will be reviewed.

   Reviewed a scatter plot of modeled to actual time element MDRs.

8. Support for the rational engineering analysis used in developing the time element hurricane vulnerability functions will be reviewed.

   Discussed that the time element vulnerability module estimates the time for repair at different building damage levels and considers downtime due to civil authority and utility failures.

   Discussed the use of RS Means costs data, post hurricane event surveys, engineering judgement, and insurance company claims data in developing the time element hurricane vulnerability functions.

9. The combination of available insurance company hurricane claims data and rational engineering analysis to develop the time element hurricane vulnerability functions will be reviewed.

   Reviewed the relationship of time element MDR to building MDR for historical and modeled results.

V-4 Hurricane Mitigation Measures and Secondary Characteristics*

*(*Significant Revision)*

A. Modeling of hurricane mitigation measures to improve a building's hurricane wind resistance, the corresponding effects on hurricane vulnerability, and associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include fixtures or construction techniques that affect the performance of the building and the damage to contents, and shall include:

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

B. The modeling organization shall justify all hurricane mitigation measures and secondary characteristics considered by the hurricane model.

C. Application of hurricane mitigation measures that affect the performance of the building and the damage to contents shall be justified as to the impact on reducing damage whether done individually or in combination.

D. Treatment of individual and combined secondary characteristics that affect the performance of the building and the damage to contents shall be justified.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

18. Form V-4, page 268: Explain the zero and non-zero values, specifically in rows for Braced Gable Ends, Garage Doors, and Mitigated Building. In particular, how are the non-zero values attributed to changes in the model vulnerability components.

Discussed the reasons for the non-zero values given in Form V-4.

19. Appendix 8, Figure 100, page 387: Provide the basis for all subcategories of roof covering in the model, their Modification Functions, and the calculations for Asphalt Shingles versus Florida Building Code (Figure 100).

    Reviewed the different roof cover options provided in the UNICEDE data dictionary.

    Discussed that the features shown in Figure 100 reflect additional supplementary information for model users.

    Reviewed the calculations of how the model derives a component response described in V-4.5.

    Reviewed modification functions for two roof cover options for a single-family structure with a 1994 roof age.

Audit

1. Supporting material for the hurricane mitigation measures and secondary characteristics vulnerability component changes in Disclosure 1 will be reviewed.

   See PVL #11.

2. Comparisons of the modified hurricane mitigation measures and secondary characteristics, if any, with the current accepted hurricane model will be reviewed.

   Reviewed the comparisons provided in Form V-5.

3. Procedures, including software, used to calculate the impact of hurricane mitigation measures and secondary characteristics will be reviewed.

   Reviewed the Individual Risk Module (IRM) code.

4. Form V-3 and Form V-5 will be reviewed.

   Reviewed Forms V-3 and V-5, and their correspondence to Forms V-2 and V-4.

   Discussed the reason for the combination of mitigation features being less than 1 when individual features had a difference greater than 1.

5. Implementation of individual hurricane mitigation measures and secondary characteristics will be reviewed as well as the effect of individual hurricane mitigation measures and secondary characteristics on damage.

   Reviewed the process for determining the impact of hurricane mitigation measures and secondary characteristics.

   Reviewed comparison between a base and a modified vulnerability function.

   Reviewed table of secondary risk features by category.

   Reviewed schematic of component interactions to calculate a modification function used in conjunction with the base function.

   Reviewed the effects of combining building features on the building damage. Discussed that the impact of secondary risk features is windspeed dependent.

6. Any variation in the change in hurricane damage over the range of windspeeds for individual hurricane mitigation measures and secondary characteristics will be reviewed.

   Discussed that component variations are intensity dependent.

7. Insurance company hurricane claims data, rational engineering analysis, or engineering judgment used to support the assumptions and implementation of the hurricane mitigation measures and secondary characteristics will be reviewed.

   Discussed that the impact of secondary risk features is not generally available in claims data.

   Reviewed comparison of company claims difference to baseline features across different secondary risk features for historical and modeled.

8. For each roof covering type used to complete Form V-2, the following will be reviewed:

   a. Roof age definition as considered in the model, including assumptions,

   Discussed that the model treats roof aging as an independent variable irrespective of roof cover type.

   b. The association between roof age and year built, including assumptions,

   Discussed that roof age is compared with building age to determine the roof year-built assignment.

c. Variation in roof age assumptions (e.g., by region or ZIP Code), and

Discussed that no regional roof age assumptions are made.

d. The impact of roof age on loss costs.

Reviewed the loss costs for the different roof age groups in Form V-3.

9. Implementation of multiple hurricane mitigation measures and secondary characteristics will be reviewed. The combined effects of these hurricane mitigation measures and secondary characteristics on damage will be reviewed. Any variation in the change in hurricane damage over the range of windspeeds for multiple hurricane mitigation measures and secondary characteristics will be reviewed.

   Reviewed under Audit 5.

10. Hurricane mitigation measures and secondary characteristics used by the hurricane model, whether or not referenced in Form V-2 and Form V-3 will be reviewed for theoretical soundness and reasonability.

    Reviewed table showing various adjustments for all model supported mitigation measures and secondary characteristics.

ACTUARIAL HURRICANE STANDARDS
Stu Mathewson, Leader

A-1 Hurricane Model Input Data and Output Reports

A. Adjustments, edits, inclusions, or deletions to insurance company or other input data used by the modeling organization shall be based upon generally accepted actuarial, underwriting, and statistical procedures.

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

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

20. A-1.B, page 144:
    a. Provide a copy of the Touchstone Exposure Data Validation Reference.

Reviewed the "Touchstone Exposure Data Validation Reference."

b. If different from the current accepted model, for one revised average default factor, provide the calculation for updating the default factor.

Discussed that no changes have been made to the calculation of default values from the current accepted model.

c. Include a sample of a hurricane model output report using the revised factor.

Reviewed an example import log that documents changes made to the data during the import process.

Reviewed an example analysis log that discloses all selections made by the model user.

Discussed that an analysis log is generated every time that the model is run.

Audit

1. Quality assurance procedures, including methods to assure accuracy of insurance or other input data, will be reviewed. Compliance with this standard will be readily demonstrated through documented rules and procedures.

   Discussed the series of processing steps for data used for modeling.

   Reviewed the "Touchstone Help for State Regulators" and the import section describing the data format used to transfer detailed exposure information to the Touchstone software, and the data elements necessary to derive loss estimates from the model.

   Reviewed the loss analysis section of "Touchstone Help for State Regulators" listing the analysis options and variables that may be selected for generating modeled losses.

   Reviewed the recommended analysis options for a Florida rate filing provided in A-1.5.

2. All hurricane model inputs and assumptions will be reviewed to determine that the hurricane model output report appropriately discloses all modifications, adjustments, assumptions, and defaults used to produce the hurricane loss costs and hurricane probable maximum loss levels.

   See PVL #20.c.

3. The hurricane model input forms used to capture data distinguishing among policy form types and their risk elements including location, deductibles, and limits of coverage will be reviewed.

   Reviewed an import form example.

4. The human-computer interface relevant to input data and output reports and corresponding nomenclature used in Florida residential property insurance rate filings will be reviewed.

   Reviewed a live demonstration of the Florida Rate Filing Analysis template with available options to the model user, and the analysis log with options selected and information required by Florida Office of Insurance Regulation.

A-2 Hurricane Events Resulting in Modeled Hurricane Losses

A. Modeled hurricane loss costs and hurricane probable maximum loss levels shall reflect all insured wind related damages from hurricanes that produce minimum damaging windspeeds or greater on land in Florida.

B. The modeling organization shall have a documented procedure for distinguishing wind-related hurricane losses from other peril losses.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

21. A-2.B, page 152: Provide a copy of the documented procedure for distinguishing wind-related hurricane losses from other peril losses.

Reviewed the documented procedure for distinguishing wind-related hurricane losses from other peril losses.

Discussed that the only peril available to model in the Florida Rate Filing Analysis template is hurricane wind.

Discussed that the required use of the Florida Rate Filing Analysis template is clearly documented in the analysis options documentation.

Reviewed the flowchart for the process to create model output.

Reviewed a comparison of an analysis log using the Florida Rate Filing Analysis template and an analysis log without using the Florida Rate Filing Analysis template.

Reviewed a live demonstration using the Florida Rate Filing Analysis template with options available to the model user.

Audit

1. The hurricane model will be reviewed to evaluate whether the determination of hurricane losses in the hurricane model is consistent with this standard.

Discussed that modeled loss costs and PML levels reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater over land in Florida.

2. The hurricane model will be reviewed to determine that by-passing hurricanes and their effects are considered in a manner that is consistent with this standard.

   Discussed that the calculation of loss costs and PMLs include the losses from all hurricanes that make landfall in Florida or are Florida by-passers. Discussed that hurricanes making a landfall in neighboring states are included as by-passers.

   Discussed that damage is included in the calculation of loss costs and PMLs from the time the hurricane first causes damaging windspeeds over land in Florida.

3. The hurricane model will be reviewed to determine whether and how the hurricane model takes into account any damage resulting directly and solely from flood (including hurricane storm surge).

   Discussed that the storm surge model is separate from the wind model and is run in parallel with the wind model.

   Discussed that storm surge losses are not output from the model when using the Florida Rate Filing Analysis template.

   Discussed that precipitation flood peril is not included in the wind model.

4. The documented procedure for distinguishing hurricane wind-only losses from other peril losses will be reviewed.

   See PVL #21.

A-3 Hurricane Coverages

A. The methods used in the calculation of building hurricane loss costs, including the effect of law and ordinance coverage, shall be actuarially sound.

B. The methods used in the calculation of appurtenant structure hurricane loss costs shall be actuarially sound.

C. The methods used in the calculation of contents hurricane loss costs shall be actuarially sound.

D. The methods used in the calculation of time element hurricane loss costs shall be actuarially sound.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

22. A-3.1-4, pages 154-155: Show a calculation of loss costs and probable maximum loss levels for the minimum Frame Owners loss costs in Form A-1 (i.e., ZIP Code 32350 in Madison County).

Reviewed the methodology for calculating average annual loss (AAL), loss costs, and probable maximum loss levels (PML).

Reviewed the equations for calculating AAL, loss costs, and PML for ZIP Code 32350 in Madison County.

Discussed that the PML methodology has not changed from the current accepted model.

Audit

1. The methods used to produce building, appurtenant structure, contents, and time element hurricane loss costs will be reviewed.

Discussed that losses are calculated by applying a coverage specific damage distribution.

Reviewed the order of coverage accumulation.

Discussed with Paul Ericksen, an external reviewer and one of the Actuarial Standards signatories, his review of the actuarial portion of the submission document. Discussed how he attested the model results to be actuarially sound.

Discussed the reasons for having two Actuarial Standards signatories.

Discussed with Glen Patashnick his involvement in reviewing the Actuarial Standards and forms. Discussed how he attested the model results to be actuarially sound.

2. The treatment of law and ordinance coverage will be reviewed, including the statutory required 25% and 50% coverage options for personal residential policies.

Discussed that law and ordinance is implicitly included in the damage functions to the extent that the claims data used to calibrate and validate the damage functions reflects law and ordinance coverage at the 25% and 50% statutory levels.

A-4 Modeled Hurricane Loss Cost and Hurricane Probable Maximum Loss Level Considerations*

*(*Significant Revision)*

A. Hurricane loss cost projections and hurricane probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

B. Hurricane loss cost projections and hurricane probable maximum loss levels shall not make a prospective provision for economic inflation.

C. Hurricane loss cost projections and hurricane probable maximum loss levels shall not include any explicit provision for direct flood losses (including those from hurricane storm surge).

D. Hurricane loss cost projections and hurricane probable maximum loss levels shall be capable of being calculated from exposures at a geocode (latitude and longitude) level of resolution.

E. Demand surge shall be included in the hurricane model's calculation of hurricane loss costs and hurricane probable maximum loss levels using relevant data and actuarially sound methods and assumptions.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

23. A-4.1, page 158: Provide, in Excel, tables of 1,000 years descending from the Top Event corresponding to Form A-8. For each year, show the value of each hurricane separately.

    Reviewed the tables of 1,000 years descending from the Top Event which showed agreement to Form A-8.

24. A-4.3, page 159: Provide a copy of the demand surge white paper.

    Reviewed the "AIR Demand Surge Function" white paper.

    Discussed that the demand surge methodology has not changed from the current accepted model.

25. A-4.5, page 160: Explain how economic inflation with regard to claims environment, the legal environment, and litigation effects are modeled.

    Discussed that the model does not make a prospective provision for economic inflation.

    Discussed that the modeler inputs replacement costs by coverage that are considered reasonable given the economic inflationary environment.

    Discussed that the process has not changed from the current accepted model.

Audit

1. The hurricane model's handling of expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, economic inflation, and any criteria other than direct residential property insurance hurricane claim payments will be reviewed.

    Discussed that the model produces pure loss estimates that do not include expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, or economic inflation.

2. The method of determining hurricane probable maximum loss levels will be reviewed.

    Reviewed the method for determining PMLs.

3. The uncertainty in the estimated annual hurricane loss costs and hurricane probable maximum loss levels will be reviewed.

    Discussed the distribution of primary and secondary uncertainty levels. Reviewed a schematic of the process.

4. The data and methods used to incorporate individual aspects of demand surge on personal and commercial residential hurricane losses, inclusive of the effects from building material costs, labor costs, contents costs, and repair time will be reviewed. The vintage of the underlying demand surge data and references will be reviewed.

    See PVL #24.

    Discussed that the demand surge methodology has not changed from the current accepted model.

5. The treatment of economic inflation and the claims and legal environments (social inflation) will be reviewed.

    Discussed that the model produces pure loss estimates and does not make prospective provisions for economic or social inflation.

Discussed that it is the modeler's responsibility to input replacement costs by coverage in the model that are reasonable given the economic inflationary environment.

Discussed that this procedure has not changed from the current accepted model.

6. The treatment of flood losses (including hurricane storm surge) in the determination of modeled hurricane losses will be reviewed.

See A-2 Audit 3.

Discussed that when using the Florida Rate Filing Analysis template, flood and storm surge losses are not included in the modeled results.

A-5 Hurricane Policy Conditions

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

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

C. Deductible hurricane loss costs shall be calculated in accordance with s. 627.701(5)(a), F.S.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. The extent that insurance company hurricane claims data are used to develop mathematical depictions of deductibles, policy limits, policy exclusions, and loss settlement provisions will be reviewed.

   Discussed that historical data are not used to develop mathematical depictions of deductibles, policy limits, policy exclusions, and loss settlement provisions.

2. The extent that insurance company hurricane claims data are used to validate the hurricane model results will be reviewed.

   Reviewed the "Claims Data Questionnaire" sent to clients when obtaining claims data that is designed to understand the nature of the claims data.

   Discussed the processing procedures of insurer claims data used for validation.

3. Treatment of annual hurricane deductibles will be reviewed.

   Reviewed the process and calculation for applying annual hurricane deductibles. Discussed that there has been no change from the current accepted model.

4. Justification for the changes from the current accepted hurricane model in the relativities among corresponding deductible amounts for the same coverage will be reviewed.

   Discussed that there has been no change in the method to estimate deductibles from the current accepted model.

Discussed that the Form A-6 deductible relativities are largely unchanged from the current accepted model.

Discussed the average change for all deductible relativities in Form A-6.

A-6 Hurricane Loss Outputs and Logical Relationships to Risk*

*(*Significant Revision)*

A. The methods, data, and assumptions used in the estimation of hurricane loss costs and hurricane probable maximum loss levels shall be actuarially sound.

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

C. Hurricane loss costs produced by the hurricane model shall be positive and non-zero for all valid Florida ZIP Codes.

D. Hurricane loss costs cannot increase as the quality of construction type, materials, and workmanship increases, all other factors held constant.

E. Hurricane loss costs cannot increase as the presence of fixtures or construction techniques designed for hazard mitigation increases, all other factors held constant.

F. Hurricane loss costs cannot increase as the wind resistant design provisions increase, all other factors held constant.

G. Hurricane loss costs cannot increase as building code enforcement increases, all other factors held constant.

H. Hurricane loss costs shall decrease as deductibles increase, all other factors held constant.

I. The relationship of hurricane loss costs for individual coverages (e.g., building, appurtenant structure, contents, and time element) shall be consistent with the coverages provided.

J. Hurricane output ranges shall be logical for the type of risk being modeled and apparent deviations shall be justified.

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

1. ***masonry construction versus frame construction,***
2. ***personal residential risk exposure versus manufactured home risk exposure,***
3. ***inland counties versus coastal counties,***

A-6 Hurricane Loss Outputs and Logical Relationships to Risk* (Continued) *(*Significant Revision)*

4. northern counties versus southern counties, and

5. newer construction versus older construction.

L. For hurricane loss cost and hurricane probable maximum loss level estimates derived from and validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) coinsurance, and (4) contractual provisions shall be appropriate based on the type of risk being modeled.

Verified: **YES**

Professional Team comments are provided in black font below.

Pre-Visit Letter

26. A-6.10, page 168: Provide the details of the calculation of the uncertainty levels.

Reviewed the methodology for calculating the uncertainty intervals for estimated loss costs.

Discussed that the exceedance probability or PML methodology has not changed from the current accepted model.

27. Form A-2, pages 274-277: Explain the differences in losses for Hurricanes NoName04-1915, Alma-1966, and Inez-1966 compared to the current accepted model.

Discussed that an incorrect historical set was imported into Touchstone for the initial submission values in Form A-2.

Reviewed a corrected Form A-2 provided with the on-site review materials on March 20, 2025. Discussed that the largest percent changes from the current accepted model and the corrected Form A-2 are for the reanalyzed storms: Hurricanes Alma (1966), Inez (1966), Abby (1968), and Gladys (1968). Discussed that additional changes in other storms are due to demand surge changes.

Discussed the plans to enhance testing of Form A-2 results.

Reviewed the process and script to generate Form A-2.

Discussed the adjustments to the Model Base Hurricane Set for completing Form A-2.

Reviewed that 19 tropical storms in the Model Hurricane Base Set were responsible for a low percentage of losses in Form A-2.

28. Form A-4, 0% Deductible, 2017 FHCF Exposure Data, pages 285-292: Explain the reversal in loss costs where Frame is less than Masonry:
    a. Owners: Gulf Average, Pasco Average, St. Johns Average
    b. Condo Unit: Franklin Average, Wakulla Average.

    Discussed that the reversals are due to the differences in building code vintage between masonry and frame construction where masonry homes are more likely pre-FBC and frame homes more likely to have been built more recently.

    Reviewed the percent of risks for pre-2001 and post-2001 in Franklin, Gulf, Pasco, St. Johns, and Wakulla Counties for frame and masonry owners and condo unit owners.

    Reviewed Form A-4 maps of loss costs.

29. Form A-5, pages 312-317: Explain the regional changes (e.g., Panhandle versus West Coast) in the loss costs in Form A-4 compared to the current accepted model.

    Discussed that the changes to the event generation component resulted in the increase in loss costs in the central region. See PVLs #2, #3, and #4 for discussion on changes to the event generation component.

Audit

1. Supporting material for the financial component changes in Disclosure 1 will be reviewed.

    Discussed that no changes were made to the financial component of the model since the current accepted model.

2. The data and methods used for hurricane probable maximum loss levels for Form A-8, will be reviewed. The hurricane associated with the Top Events will be reviewed.

    See PVL #23.

3. The frequency distribution and the individual event severity distribution, or information about the formulation of events, underlying Form A-8 will be reviewed.

    Discussed that the model produces an empirical total loss distribution that can be separated into frequency and severity distributions.

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

   Reviewed maps of loss costs by ZIP Code and by County for frame owners and masonry owners.

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

   Reviewed maps of the average land friction factors and the east direction friction factors.

6. The procedures used by the modeling organization to verify the individual hurricane loss cost relationships will be reviewed. Methods (including any software) used in verifying Hurricane Standard A-6 will be reviewed.

   Discussed the code used for handling the data, automation of the forms, processing the results, and to facilitate the verification process.

   Discussed the code developed to evaluate apparent reversals, plot results, and create verification exhibits.

   Discussed that forms are also directly reviewed for reasonableness by modeling personnel.

7. The hurricane loss cost relationships among deductible, policy form, construction type, coverage, year of construction, building strength, number of stories, territory, and region will be reviewed.

   Reviewed Form A-6 graphical representations of the loss costs relationships and confirmed reasonability.

8. Justification for all changes in hurricane loss costs from the current accepted hurricane model will be reviewed.

   Discussed that the loss costs changes from the current acceptable model are all attributable to the 3 component changes: event generation data, building vulnerability, and ZIP Code data.

9. Apparent reversals in the hurricane output ranges and their justification will be reviewed.

   See PVL #28.

10. The details on the calculation of uncertainty intervals and their justification will be reviewed.

    See PVL #26.

COMPUTER/INFORMATION HURRICANE STANDARDS
Kevin Moran, Leader

CI-1 Hurricane Model Documentation*
*(*Significant Revision)*

A. Hurricane model functionality and technical descriptions shall be documented formally in an archival format separate from the use of correspondence including emails, presentation materials, and unformatted text files.

B. All documentation, code, and scripts shall be located in central repositories controlled by repository software. Repository software shall support track changes, versioning, and collaborative editing.

C. All computer software relevant to the hurricane model shall be consistently documented and dated.

D. The following shall be maintained: (1) a table of all changes in the hurricane model from the current accepted hurricane model to the initial submission this year, and (2) a table of all substantive changes since this year's initial submission.

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

F. A list of all externally acquired, currently used, hurricane model-specific software and data assets shall be maintained. The list shall include (1) asset name, (2) asset version number, (3) asset acquisition date, (4) asset acquisition source, (5) asset acquisition mode (e.g., lease, purchase, open source), and (6) length of time asset has been in use by the modeling organization.

Verified: YES

Professional Team comments are provided in black font below.

Discussed with Robert Cabeca, an external reviewer and Computer/Information Standards signatory, his review of the model for compliance with the Computer/Information Standards. Discussed the findings in his model evaluation report and recommendations for greater compliance with the standards.

Audit

1. The central repositories will be reviewed.

   Discussed that version-specific documentation, including requirements, design documents, test plans, and project schedules, are stored in the Touchstone Team Foundation Version Control repository.

   Reviewed an example of the documentation storage hierarchy and contents of recent Touchstone Releases.

   Discussed that reference and some internal process documentation is managed in the Azure Development Operations repository.

   Discussed that product source code is managed in the Team Foundation repository.

   Reviewed "Touchstone Help for State Regulators" user documentation.

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

   Reviewed the "Touchstone Help for State Regulators" user documentation that is published as a web help tool.

3. Modeling organization personnel, or their designated proxies, responsible for each aspect of the software (i.e., user interface, quality assurance, engineering, actuarial, verification) shall be present when the Computer/Information Hurricane Standards are being reviewed. Internal users of the software will be interviewed.

   All subject matter experts and personnel involved in software implementation were available and participated throughout the audit.

4. Verification that documentation is created separately from, and is maintained consistently with, the source code will be reviewed.

   Discussed that documentation is created separately and maintained consistently with the source code.

   Discussed the shift to the Azure Team Foundation storage platform for data storage.

   Discussed the traceability of artifacts from the requirements documentation to the source code.

   Discussed the use of the Team Foundation version control.

5. The list of all externally acquired hurricane model-specific software and data assets will be reviewed.

   Reviewed the list of externally acquired hurricane model-specific software and data sources.

6. The tables specified in Hurricane Standard CI-1.D that contain the items listed in Hurricane Standard G-1, Disclosure 7 will be reviewed. The tables shall contain the item number in the first column. The remaining five columns shall contain specific document or file references for affected components or data relating to Computer/Information Hurricane Standards CI-2, CI-3, CI-4, CI-5, and CI-7.

   Reviewed the "Enhancement Maps Touchstone 2024A" with the required information.

7. Tracing of the hurricane model changes specified in Hurricane Standard G-1, Disclosure 7 and Audit 4 through all Computer/Information Hurricane Standards will be reviewed.

   Reviewed the "Enhancement Maps Touchstone 2024A," tracing the hurricane model changes given in G-1.7 through all the Computer/Information Standards.

CI-2 Hurricane Model Requirements*

*(*Significant Revision)*

A complete set of requirements for each software component, as well as for each database or data file accessed by a component, shall be maintained. Requirements shall be updated whenever changes are made to the hurricane model.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. Maintenance and documentation of a complete set of requirements for each software component, database, and data file accessed by a component will be reviewed.

   Reviewed the "Model 521 Scope and Requirements Document" with the requirements documentation for the model under review.

   Discussed that requirements documentation is created separately for each software release.

   Reviewed the structure of an example requirements document.

2. Requirements documentation specifically relating to each model change identified in Hurricane Standard G-1, Disclosure 7 will be reviewed.

   Reviewed the requirements documentation in "Touchstone Releases" for the event generation update, the building vulnerability updates, and the ZIP Code updates.

CI-3 Hurricane Model Organization and Component Design

A. The following shall be maintained and documented: (1) detailed control and data flowcharts and interface specifications for each software component, (2) schema definitions for each database and data file, (3) flowcharts illustrating hurricane model-related flow of information and its processing by modeling organization personnel or consultants, (4) network organization, and (5) system model representations associated with (1)-(4) above. Documentation shall be to the level of components that make significant contributions to the hurricane model output.

B. All flowcharts (e.g., software, data, and system models) in the submission or in other relevant documentation shall be based on (1) a referenced industry standard (e.g., UML, BPMN, SysML), or (2) a comparable internally developed standard which is separately documented.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. The following will be reviewed:

    a. Detailed control and data flowcharts, completely and sufficiently labeled for each component,

    Reviewed the following control and data flow diagrams:

    - Catalog Creation and Validation
    - Individual Risk Module Overview
    - Loss Data Creation and Verification
    - Physical Properties Testing and Verification
    - ZIPALL Database Creation

    Reviewed the Individual Risk Module (IRM) overview flowchart.

    Reviewed the flowchart to develop the roof system.

    Reviewed other flowcharts throughout the audit.

b. Interface specifications for all components in the hurricane model,

Reviewed the interface specifications in the "M521 Scope and Requirements Document."

c. Documentation for schemas for all data files, along with field type definitions,

Reviewed the data files and databases discussed in the following documents:

- Touchstone Database Reference
- Catalog Generation
- Physical Properties
- HURSIM
- Model 521 Catastrophe Model Implementation

d. Each network flowchart including components, sub-component flowcharts, arcs, and labels,

Flowcharts were reviewed throughout the audit.

e. Flowcharts illustrating hurricane model-related information flow among modeling organization personnel or consultants (e.g., BPMN, UML, SysML, or equivalent technique including a modeling organization internal standard), and

Reviewed example flowcharts illustrating information flow among internal personnel.

f. If the hurricane model is implemented on more than one platform, the detailed control and data flowcharts, component interface specifications, schema documentation for all data files, and detailed network flowcharts for each platform.

Discussed that the model is implemented on a single platform.

Reviewed schematics of the Touchstone system tiers and the models housed in Touchstone.

Reviewed schematics of the Touchstone network layout and the Touchstone-client-server system architecture.

2. The flowchart reference guide or industry standard reference will be reviewed.

Reviewed the Verisk flowchart standards.

CI-4 Hurricane Model Implementation*

*(*Significant Revision)*

A. A complete procedure of coding guidelines consistent with accepted practices shall be maintained. Coding guidelines shall be referenced for each programming language used in the hurricane model or submission document.

B. Network organization documentation shall be maintained.

C. A complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components shall be maintained.

D. All components shall be traceable, through explicit component identification in the hurricane model representations (e.g., requirements, flowcharts) down to the implementation level.

E. A table of all software components affecting hurricane loss costs and hurricane probable maximum loss levels shall be maintained with the following table columns: (1) component name, (2) number of lines of code, minus blank and comment lines, and (3) number of explanatory comment lines.

F. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

G. The following documentation shall be maintained for all components or data modified by items identified in Hurricane Standard G-1, Disclosure 7 and Audit 4:

1. A list of all equations and formulas used in documentation of the hurricane model with definitions of all terms and variables, and

2. A cross-referenced list of implementation source code terms and variable names corresponding to items within G.1 above.

H. Hurricane model code and data shall be accompanied by documented review plans, testing plans, and if needed, update plans through regularly scheduled intervals. The vintage of the hurricane model code and data shall be justified.

Verified: YES

Professional Team comments are provided in black font below.

During the April 3, 2025 virtual review, reviewed the variable mapping for the function to calculate wind at any location.

Pre-Visit Letter

30. CI-4: Discuss process improvements in documentation relative to mathematical expressions and variable mapping as given in the 2023 Professional Team On-Site Review Report.

    Reviewed documentation for the Model 521 equations, formulas, variable mapping, and cross-checking procedures developed to improve the accuracy of variable naming and the mathematical equations process.

    Reviewed an example equation and its variable mapping and crosscheck verification.

31. CI-4: Discuss improvements in the software training process as documented in the 2023 Professional Team On-Site Review Report.

    Reviewed the software training process in the "Verisk Learning Center Trainings" documentation.

32. CI-4: Discuss process improvements in the plan to review and update the "Coding Standards Training to increase emphasis on code review and logical checks" as documented in the 2023 Professional Team On-Site Review Report.

    Reviewed the "Verisk Coding Guidelines" that were expanded to include new languages across the full spectrum of model codes.

    Discussed the coding standard meetings held with researchers to develop additional languages.

    See PVL #34 for additional testing developed.

33. CI-4: Discuss process improvements in the automated form scripts for the actuarial forms as documented in the 2023 Professional Team On-Site Review Report.

    Discussed that new automation scripts were added for the creation of the actuarial forms.

    Discussed that the historical catalog is manually uploaded into the software platform. This manual process led to the errors in Forms S-4, S-5, A-2, and A-3. Discussed plans to automate the process in the future.

Discussed additional code developed for forms to run logical checks and identify potential concerns. Discussed that the codes will continue to be developed to address other checks and to look at the differences between model versions.

Audit

1. Code and data implementations, for at least the meteorology, vulnerability, and actuarial components, will be reviewed.

   Reviewed the flowchart, requirements, and source code for the year-built update.

   Reviewed the flowchart, requirements, design, and source code for the roof age update.

   Reviewed the flowchart and source code for calculating hurricane surface winds confirming the implementation of the order of operations in the calculation.

2. The documented coding guidelines, including procedures for ensuring readable identifiers for variables, constants, and components, and confirmation that these guidelines are uniformly implemented will be reviewed.

   Reviewed the Verisk Coding Guidelines.

   Discussed that developers are required to undergo training to ensure that they understand the guidelines.

   Discussed the tools and processes for enforcing coding standards.

   Discussed the process for testing of code.

3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.

   Reviewed the procedures for generating the ZIPALL files and Touchstone databases.

   Reviewed the procedures for generating the model data files for stochastic catalog creation and validation, and physical properties testing and verification.

   Reviewed procedures documented in “Model 521 Catastrophe Model Implementation.”

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

   Reviewed the “Enhancement Maps Touchstone 2024A” documentation which identifies the support documentation for each specific change.

Discussed that documentation provides traceability at all levels, including requirements, design, implementation, verification, and testing.

Discussed that the documentation contains all of the mathematical equations.

5. The following information will be reviewed for each component, either in a header comment block, source control database, or the documentation:
   a. Component name,
   b. Date created,
   c. Dates modified, modification rationale, and by whom,
   d. Purpose or function of the component, and
   e. Input and output parameter definitions.

   Discussed that the information is reflected in either the source code or in the Team Foundation Version Control (TFVC) server.

6. The table of all software components as specified in Hurricane Standard CI-4.E will be reviewed.

   Reviewed the "Line Counts" document with the component name, number of lines of code, blank lines, and the number of comment lines.

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

   Reviewed the "Model 521 Catastrophe Model Implementation" and "Touchstone Hazard Model Framework" documentation mapping elements in the source code.

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

   Reviewed comments in selected source code examined throughout the audit.

9. Unique aspects within various platforms with regard to the use of hardware, operating system, and essential software will be reviewed.

   Discussed that Touchstone is a multi-layer client-server application that is designed to run on a single platform.

   Reviewed a diagram of the Touchstone network layout.

10. Network organization implementation will be reviewed.

    Reviewed diagrams of the Touchstone network organization implementation.

11. Code and data review plans, testing plans, update plans, and schedules will be reviewed. Justification for the vintage of code and data will be reviewed.

    Discussed that the source code is version controlled in TFVC.

    Discussed the process for version control of all code changes.

    Discussed the schedule for software updates and the process followed.

    Reviewed the "Touchstone Branching Strategy" documenting the branching and maintenance guidelines. Discussed justification for the branching methodology.

    Reviewed the updated plans and schedules documented in "Touchstone Sprint Schedule," "Touchstone 2024A (12.1) (FCHLPM) Release," and in the data file maintenance chapter in "Model 521 Catastrophe Model Implementation."

12. Automated procedures used to create forms will be reviewed.

    Discussed that automated procedures exist for form creation across all standards.

    Reviewed the process and script to generate Form A-2.

    See PVLs #27 and #33.

CI-5 Hurricane Model Verification*

*(*Significant Revision)*

A. General

For each component, procedures shall be maintained for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeling organization personnel other than the original component developers.

B. Component Testing

1. Testing software shall be used to assist in documenting and analyzing all components.

2. Unit tests shall be performed and documented for each updated component.

3. Regression tests shall be performed and documented on incremental builds.

4. Integration tests shall be performed and documented to ensure the correctness of all hurricane model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

C. Data Testing

1. Testing software shall be used to assist in documenting and analyzing all databases and data files accessed by components.

2. Integrity, consistency, and correctness checks shall be performed and documented on all databases and data files accessed by the components.

Verified: YES

Professional Team comments are provided in black font below.

Pre-Visit Letter

34. CI-5: Discuss the process improvements in explicit testing designed to catch implementation errors in Touchstone platforms at an earlier stage as documented in the 2023 Professional Team On-Site Review Report.

    Discussed the ongoing efforts to enhance testing for model-agnostic components of the platform.

    Reviewed the explicit test coverage and expanded validation for correlation files and order of accumulation that has been implemented.

    Discussed that test suites are automated and executed across every major software iteration to ensure earlier error detection and reliability.

Audit

1. Procedures for physical unit conversion verification (e.g., knots to mph) will be reviewed.

    Reviewed the "Unit Conversion Verification" documentation.

    Discussed that updates and transformations are reviewed between the implementation team and the research team.

    Discussed that there have been no changes in physical unit conversions in the source code.

2. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.

    Reviewed sample flag-triggered output statements and statements for error and exception handling in "Model 521 Logical assertions, Exception handling, and Flag triggered outputs."

3. The testing software used by the modeling organization will be reviewed.

    Reviewed the "Summary of Quality Assurance Process" and the software tools used during testing and validation.

4. The component (unit, regression, integration) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.

    Reviewed the "M521 QA Test Plans V12.1."

Reviewed the procedure followed for developing test plans documented in the "Summary of the Quality Assurance Process" and in "Touchstone Testing Process Flowchart."

Reviewed the test plan for integration testing on the unknown year-built vulnerability update.

Discussed the frequency of automated integration test runs. Discussed the decision to use functional coverage in the testing runs.

Reviewed an example of an automated test report.

Reviewed the script for testing of Form A-2 results. Discussed the manual steps in the testing process and plans to improve and further automate the testing.

5. Fully time-stamped, documented cross-checking procedures and results for verifying equations, including tester identification, will be reviewed. Examples include mathematical calculations versus source code implementation or the use of multiple implementations using different languages.

Reviewed examples of cross-checking procedures and results for verifying equations in the "Model 521 Equations, Formulas, Variable Mapping and Cross Checking" documentation.

6. Flowcharts defining the processes used for manual and automatic verification will be reviewed.

Reviewed the testing workflows in "Touchstone Testing Process Flowchart" documentation.

Reviewed flowcharts defining where validation occurs during the development and implementation processes.

7. Verification approaches used for externally acquired data, software, and models will be reviewed.

Discussed the validation process for external source data.

Reviewed the validation process of Claritas census block population weights and ZIP Code centroid data.

Reviewed the validation process of United States Geological Survey (USGS) National Land Cover Database (NLCD) data.

8. Complete and thorough verification procedures and output from the model changes identified in Hurricane Standard G-1, Disclosure 7 will be reviewed.

Reviewed "M521 QA Test Plans V.12.1."

CI-6 Human-Computer Interaction

A. Interfaces shall be implemented as consistent with accepted principles and practices of Human-Computer Interaction (HCI), Interaction Design, and User Experience (UX) engineering.

B. Interface options used in the hurricane model shall be unique, explicit, and distinctly emphasized.

C. For a Florida insurance rate filing, interface options shall be limited to those options found acceptable by the Commission.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. External and internal user interfaces will be reviewed.

   Reviewed the Florida Rate Filing Analysis template.

   Reviewed a live demonstration of the interface.

2. Documentation related to HCI, Interaction Design, and UX engineering will be reviewed.

   Reviewed the following documentation:
   - User Story – Update Florida Rate Filing Analysis Template
   - Invoking the Florida Rate Filing Analysis Template in the Detailed Loss Configuration

   Discussed the process of using heuristic evaluations and design critiques to validate UI/UX design.

3. The decision process specifying the logic of interface option selections, when an acceptable hurricane model is selected, will be reviewed.

   Reviewed the design, implementation, and evaluation process for the interface options.

CI-7 Hurricane Model Maintenance and Revision*

*(*Significant Revision)*

A. A clearly written policy shall be implemented for review, maintenance, and revision of the hurricane model and network organization, including verification and validation of revised components, databases, and data files.

B. A revision to any portion of the hurricane model that results in a change in any Florida personal and commercial residential hurricane loss cost or hurricane probable maximum loss level shall result in a new hurricane model version identification.

C. A list of all hurricane model versions since the initial submission for this year shall be maintained. Each hurricane model description shall have a unique version identification and a list of additions, deletions, and changes that define that version.

Verified: YES

Professional Team comments are provided in black font below.

Audit

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

   Reviewed the "Version Change Management Process" documentation with procedures followed for maintaining code, data, and documentation.

   Discussed that TFVC, Azure DevOps, and Microsoft Office SharePoint Server are tracking mechanisms used.

   Discussed the process for tracking and documenting potential bugs.

2. The policy for hurricane model revision and management will be reviewed.

   Reviewed the model and software revision policies for management, version numbering, change control process, software change management, software change management workflow, and model change management workflow.

3. Portions of the code, not necessarily related to recent changes in the hurricane model, will be reviewed.

   Code reviews were conducted as listed under CI-4.

4. The tracking software will be reviewed and checked for the ability to track date and time.

   Discussed that TFVC, Azure DevOps, and Microsoft Office SharePoint Server are the software used for tracking.

5. The list of all hurricane model revisions as specified in Hurricane Standard CI-7.C will be reviewed.

   Reviewed the "Version Change History" documentation listing the version changes for each Touchstone and U.S. hurricane model release.

6. The model version history over the past 5 years, leading up to the version submitted will be reviewed.

   Reviewed the model and software platform version history.

CI-8 Hurricane Model Security*

*(*Significant Revision)*

Security procedures shall be implemented and fully documented for (1) secure access to individual computers where the software components or data can be created or modified, (2) secure operation of the hurricane model by clients, if relevant, to ensure that the correct software operation cannot be compromised, (3) anti-virus software installation for all machines where all components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.

Verified: YES

Professional Team comments are provided in black font below.

Audit

1. The written policy for all security procedures and methods used to ensure the security of code, data, and documentation will be reviewed.

   Reviewed the security processes and procedures that align to "Verisk's Corporate Information Security" policies.

2. Documented security procedures for access, client hurricane model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

   Reviewed the "Touchstone/Re Installation Guide" addressing the processes and procedures for Touchstone.

3. Security aspects of each platform will be reviewed.

   Discussed that Touchstone runs on a single platform, and that the "Touchstone/Re Installation Guide" provides guidance and best practices in user management, user access control, anti-virus usage, and securing each model release.

4. Network security documentation and network integrity assurance procedures will be reviewed.

   Reviewed the "Verisk Information Security Policy Framework" containing the corporate information security policies followed.

Commission Issue

Specify if and where Artificial Intelligence (AI) is used (e.g., development, implementation, testing, data analysis, documentation). If used, explain how AI is employed along with what AI models (in-house, proprietary, or open source) and inference are implemented. For any training performed by the modeling organization, specify whether fine-tuning is done or whether the AI model is trained from scratch. Specify the AI model types, learning algorithms, training data, testing data, and measures of effectiveness.

Discussed the AI was not used in the development of the Verisk Hurricane Model for the United States version 3.0.0.

Discussed AI use cases for future model submissions which will be discussed with the Commission during the trade secret session of the June 2025 meeting to review the model for acceptability.