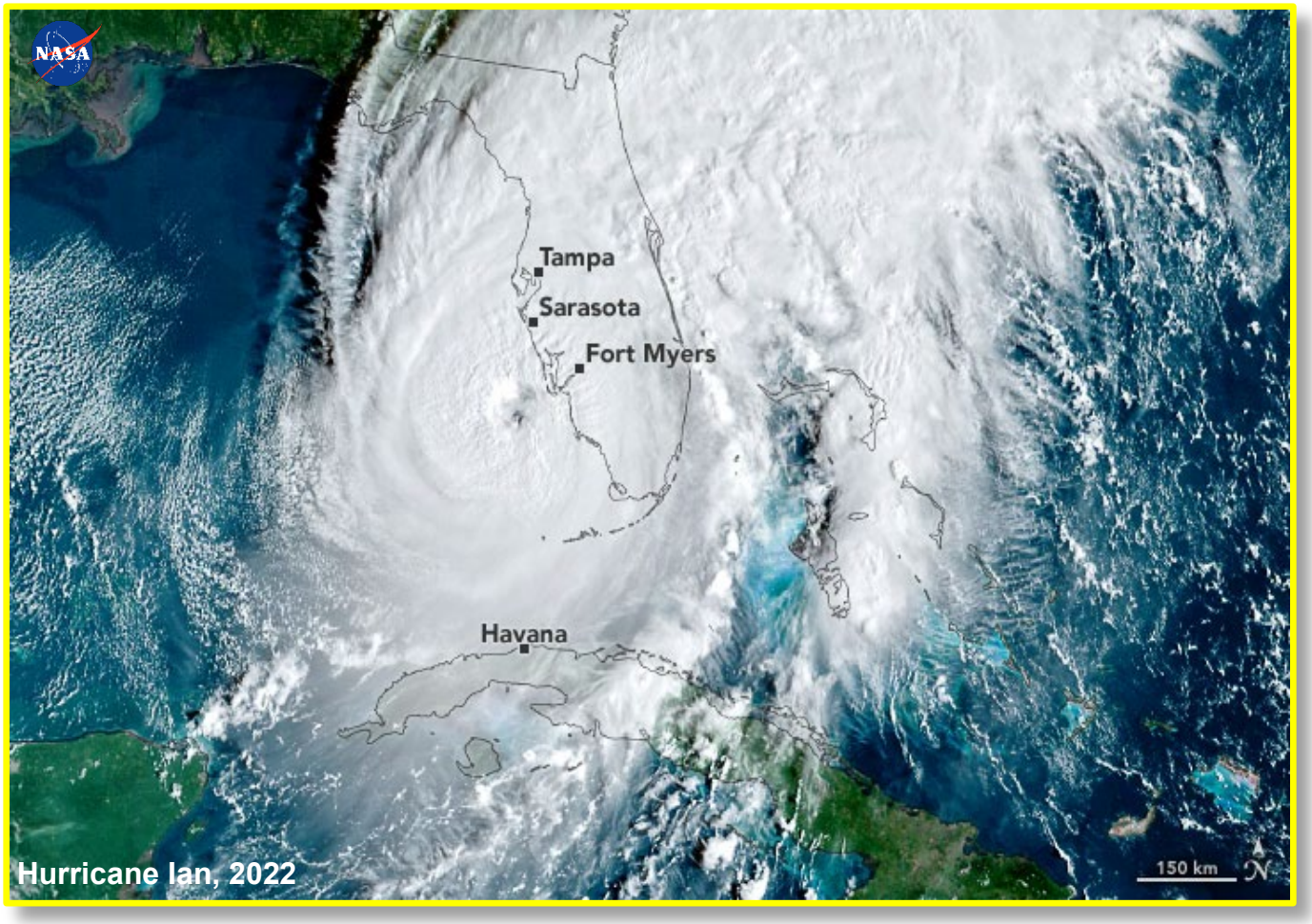
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report

2023 Hurricane Standards



Florida International University

On-Site Review: May 27-29, 2025

On May 27-29, 2025, the Professional Team conducted an on-site review of the Florida Public Hurricane Loss Model (FPHLM) Version 8.3 at Florida International University (FIU). The following individuals participated in the review.

FPHLM

Bachir Annane, Ph.D., Senior Research Associate III, Hurricane Research Division – CIMAS, NOAA Atlantic Oceanographic and Meteorological Laboratory, Miami, Florida
Shu-Ching Chen, Ph.D., Professor and Executive Director, Data Science and Analytics Innovation Center, University of Missouri-Kansas City
Steve Cocke, Ph.D., Senior Research Scientist, Center for Ocean-Atmospheric Prediction Studies, Florida State University
Gail Flannery, FCAS, MAAA, Consulting Actuary, AMI Risk Consultants, Inc., Miami, Florida
Kurt Gurley, Ph.D., Professor and Associate Director, Department of Civil and Coastal Engineering, University of Florida
Shahid Hamid, Ph.D., CFA, Professor, Department of Finance, College of Business, and Director, Laboratory for Insurance, Financial and Economic Research, International Hurricane Research Center, Florida International University
B.M. Golam Kibria, Ph.D., Professor, Mathematics and Statistics, College of Arts, Sciences & Education, Florida International University
Mohammad Akbari Lor, Ph.D. Student in Computer Science, University of Missouri-Kansas City
Mohammad Noman, Ph.D. Candidate in Structural and Wind Engineering, University of Florida
Jainil Anilkumar Patel, Ph.D. Student and Graduate Assistant in Computer Science, University of Missouri-Kansas City
Jean-Paul Pinelli, Ph.D., P.E., Professor, College of Engineering and Science – Mechanical and Civil Engineering, Florida Institute of Technology
Mei-Ling Shyu, Ph.D., Professor, Electrical and Computer Engineering, Division of Energy, Matter and Systems, School of Science and Engineering, University of Missouri-Kansas City
Tianyi Wang, Ph.D., Computer Scientist, Extreme Events Institute, Florida International University
Wensong Wu, Ph.D., Associate Professor, Mathematics and Statistics, College of Arts, Sciences & Education, Florida International University

Professional Team

Jimmy Booth, Ph.D., Meteorology
Paul Fishwick, Ph.D., Computer/Information
Chris Jones, P.E., Vulnerability
Steve Kolk, ACAS, MAAA, Actuarial
Chris Nachtsheim, Ph.D., Statistics, Team Leader
Donna Sirmons, Staff

The Professional Team began the review with an opening briefing and expressed their appreciation and thanks to the modeling team for accommodating the rescheduling of the on-site review from the original dates in April. FIU provided a general overview of the hurricane model discussing the participating institutions and the funding to operate, update, and maintain the model. FIU next explained the model updates in version 8.3.

- Historical storms updated through the 2023 hurricane season
- Empirical probability distribution functions used in the storm track generator were updated to include more recent events through the 2023 hurricane season
- ZIP Code database and ZIP Code-based databases updated to the April 2024 ZIP Code boundaries

FIU explained the impacts of the model updates on loss costs. The combined model updates resulted in a 0.8% increase in the average annual zero deductible statewide hurricane loss costs. Updates in HURDAT2 increased the loss costs by 4.2%, the revised roughness had a 0% change in loss costs, and additional exposures qualifying for lower retrofitted vulnerabilities due to the age of the exposures reduced the loss costs by 3.5%.

The audit continued with a review of each standards section.

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. Form A-1.F, page 378: Incomplete. Rationale and a detailed description of how the assumptions are implemented not provided.

2. Form A-2.B, page 381: Non-responsive. Response not provided.

3. Form A-4.I, page 437: Incomplete. Rationale and a detailed description of how the assumptions are implemented not provided.

4. Form S-4.B, page 584: Incomplete. Provide a definition of the model relevant commercial residential classifications used.

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 FIU'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 FIU. 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. FIU 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. FIU 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 FIU 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 November 8, 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, different Professional Team members will be attending. Please have available 6 printed copies of the presentations (printed two slides per page and duplexed), and 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
Chris Nachtsheim, 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 26: Discuss how the equilibrium layer in the slab planetary boundary layer (PBL) impacts the surface wind since the internal boundary layer (IBL) at the surface is directly impacted by surface friction.

   Discussed that the method for sea to land transition is only used for coastal transition adjustments of windspeeds and does not apply to the slab model which models the entire PBL as a single layer.

Discussed that the equilibrium layer methodology is used to correct surface winds for terrain conditions.

Discussed that the equilibrium layer height is empirically approximated to be 1/10 of the IBL height, based on Schmidt and Oke (1990).

Reviewed the methodology for computing the vertical wind profile and actual inland terrain winds directly from winds at top of the boundary layer.

Reviewed the methodology for coastal transition adjustments of winds. Discussed that winds on barrier islands or at the coast are modeled as marine winds.

2. G-1.2, page 32: Explain the validity and impact of the assumption that all Manufactured Homes are single-wide.

Discussed that exposure data for manufactured homes rarely includes the footprint of the manufactured home unit, and that the value of the manufactured homes inventory in Florida is small in proportion to site-built homes, so that having multiple sizes of manufactured homes would have very little influence. Discussed that the most critical element for manufactured homes is pre- and post-HUD 1994 construction, which the model does distinguish.

Discussed that the damage ratios are similar between single-wide and double-wide manufactured homes as a manufactured home with twice the value and twice the size of a single-wide has twice as much damage with the damage ratios for both sizes being approximately equal.

3. G-1.7.C and D, Figures 16-19, pages 104-107: Discuss the individual and cumulative changes in loss costs for Monroe County.

Reviewed the loss cost changes in Monroe County. Discussed that the age of exposures qualifying for the lower retrofitted vulnerabilities, e.g., re-roofed, resulted in the overall decrease in loss costs. Reviewed a table of the construction years 1902-03, 1932-33, 1962-63, and 1992-93 that are new to retrofitting qualifications in the model.

Discussed the model assumption that a 25+ age roof has been replaced.

Audit

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

Reviewed a corrected Figure 1 flowchart of the process for assuring continual agreement and correct correspondence of databases, data files, and computer source code. Reviewed several examples throughout the audit.

Discussed that flowchart labels were corrected to be relevant to the hurricane model.

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. Revised 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 vintage of various model datasets. Discussed that the model code is compliant with contemporary and widely used programming language standards. Discussed that the scientific and technical literature used or produced by modeling personnel reflect the current understanding of the methods, concepts, and results relevant to catastrophe modeling.

   Discussed justification of the vintage for the geographic regions shown in Figure 9 as no changes have been made to the vulnerability personal residential model since version 6.2 under the 2017 Hurricane Standards. Discussed that statistics are available for all counties but one.

   Discussed that no post-2004 damage observations have been used to validate interior and utilities predictions.

   Discussed justification for the vintage of the 2008 RSMeans costs data for estimating the cost of repairing building damage.

   Discussed that the Florida Building Code used by the model requires replacement of the entire roof if 25% or more of the roof cover is damaged.

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

   Reviewed the supporting material for the hazard model updates under the Meteorological Standards.

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.

   Confirmed 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.

   Confirmed 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

4. G-2.2.B, page 114: Provide resumes of the new personnel.

Reviewed resumes of new personnel:

- Adruja Ghosh, B.S. Student in Computer Science, University of Missouri, Kansas City, MO
- Shaian Khan, Ph.D. Candidate in Data Science, University of Missouri, Kansas City, MO; M.S. in Computer Science, University of Missouri, Kansas City, MO; B.S. in Electrical and Electronic Engineering, BRAC University, Dhaka, Bangladesh
- Namuun Lkhagvadorj, M.S. in Data Science Analytics, University of Missouri, Kansas City, MO; B.B.A. in Finance, National University of Mongolia, Ulaanbaatar City, Mongolia

- Mohammadreza Akbari Lor, Ph.D. Student in Computer Science, University of Missouri, Kansas City, MO; M.S. in Computer Science, University of Missouri, Kansas City, MO; MBA in Executive Management, Management Development Institute of Higher Education, Tehran, Iran; B.S. in Mathematics and Applications, Ferdowsi University of Mashhad, Mashhad, Iran

- Mohammad Noman, Ph.D. Candidate in Structural and Wind Engineering, University of Florida, Gainesville, FL; M.S. in Structural Engineering, University of Engineering and Technology, Taxila, Pakistan; B.S. in Civil Engineering, University of Engineering and Technology, Taxila, Pakistan

- Jainil Anilkumar Patel, Ph.D. Student in Computer Science, University of Missouri, Kansas City, MO; M.Tech. in Computer Science and Engineering, Nirma Institute of Science and Technology, Ahmedabad, India; B.Tech. in Computer Science, Charotar University of Science and Technology, Gujarat, India

- Suryansh Patel, M.S. Student in Computer Science, University of Missouri, Kansas City, MO; B.Tech. in Computer Science and Engineering, Lakshmi Narain College of Technology, Bhopal, Madhya Pradesh, India

- Bhanu Vodinepally, M.S. Student in Computer Science, University of Missouri, Kansas City, MO; B.Tech. in Computer Science and Engineering, Vardhaman College of Engineering, Hyderabad, India

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 #4 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 such incidents to report.

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 the changes in population-weighted centroids.

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

   Reviewed geographic representation comparing the ZIP Code boundary changes from the current accepted model.

   Reviewed geographic comparisons of ZIP Code centroid movements from the current accepted model.

   Discussed that the change in ZIP Code boundaries had no effect on ZIP Code centroids.

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 the ZIP Code data obtained from Zip-Codes.com.

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

   Discussed that policies over water or uninhabitable terrain are removed.

   Discussed that the client is contacted to clarify problems encountered with the supplied exposure data.

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

   Discussed that policies with incomplete addresses are removed.

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

   Discussed that street addresses are requested from the Office of Insurance Regulation.

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

   Reviewed the databases that are ZIP Code based given in G-3.5.

   Discussed that the updated ZIP Code boundaries led to changes in ZIP-Code based roughness values, but no changes to street level roughness values.

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.

   No evidence was seen 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 previous submission 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 Dr. Steve Cocke, the editorial compliance signatory, who reviewed the submission document.

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 that the model submission was reviewed throughout the development process for grammatical correctness, typographical accuracy, and completeness.

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.

   Confirmation was given that subject matter experts reviewed all submitted materials for completeness and accuracy.

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

   Reviewed various track changes in the submission document.

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

   Reviewed a flowchart of the form completion process.

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
Jimmy Booth, 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.

Pre-Visit Letter

5. M-1.8, Figure 23, page 133: Explain the large discrepancies for modeled versus observed occurrences at Port St. Lucie.

   Discussed that the Chi-square and Kolmogorov-Smirnov statistical tests indicated the differences could be attributed to sampling error with the differences not being statistically significant.

   Discussed that the sampling anomaly relates to Port St. Lucie having 3 landfalling storms out of 11 storms at 74mph that might not have been hurricanes due to uncertainty in storm intensities, and a high ratio of multi-events years.

6. Form M-1.B, page 560: Provide the report detailing how the counts were determined.

   Discussed the process for determining historical and stochastic storm counts in Form M-1. Discussed that bypassing storms are included in the counts.

   Discussed that a script is used to read the historical and stochastic storm counts and to compute the entries in Form M-1. Discussed that the historical storm values are also computed for Form S-1 and Form A-2.

Audit

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

   Discussed that the Model Hurricane Base Set is the Reference Hurricane Set with the additional 2023 season based on HURDAT2 as of May 11, 2024, and small modifications based on decisions related to landfall for early 20th century storms.

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 flowchart for processing HURDAT2 data in generating output for the storm track generator.

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

   Reviewed Hurricanes Ian (2022), Nicole (2022), and Idalia (2023) added to the Model Base Hurricane Set. Discussed the impact on loss costs of the storms in their landfalling regions.

   Reviewed comparison of historical to modeled landfall occurrence rate by milepost.

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 the annual occurrence rates of Florida landfalling hurricanes in Form M-1 compared to Forms S-1 and A-2. Discussed the consistency in storm counts among the forms.

   Reviewed the *p*-values from the goodness-of-fit tests for statewide and regional hurricane frequencies.

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

   Not applicable.

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.

Audit

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

   Reviewed HURDAT2 updates for Hurricanes Ian (2022), Nicole (2022), and Idalia (2023) added to the Model Base Hurricane Set.

   Reviewed updates to the ZIP Code boundaries which led to changes in the ZIP Code-based roughness values. Discussed that the updated ZIP Code boundaries caused no changes to street level roughness values.

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

   Reviewed the information on hurricane parameters provided in M-2.2, 4, and 6, and G-1.2.

   Discussed that no hurricane parameters are adjusted for climate change.

   Discussed that the gradient wind profile is derived from the pressure profile and that the *Holland B* surface pressure profile parameter is used to initialize winds in the slab model.

   Reviewed implementation of the *Holland B* parameter.

   Discussed how stochastic tracks are developed for the model.

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,
   b. The modeled dependencies among correlated parameters in the windfield component and how they are represented, and
   c. The parameters affecting asymmetric structure of hurricanes.

   Reviewed the graphical depictions of hurricane parameters provided in G-1.2 and S-1.8. Reviewed the modeled dependencies among parameters described in M-2.2 and G-1.2.

   Reviewed the parameters affecting asymmetric structure described in M-6.1, G-1.2, and Powell et al. 2005.

   Discussed that the storm track speed and track direction parameters are empirical distributions involving no parameter estimations with the values constrained to observations.

   Reviewed comparison of modeled to observed Rmax in Figure 36. Discussed that Rmax is modeled based on a gamma distribution because the gamma distribution produced the best fit compared to the other distributions tried.

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.

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 *p*-values from the goodness-of-fit tests for Alabama, Georgia, and Mississippi under M-1, Audit 4.

   Discussed the definition of a bypassing event in the model.

   Reviewed the Form M-1 comparisons of modeled and historical landfall frequency for neighboring states. Discussed that the statistical tests are sensitive to bin size because of the paucity of data.

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

   Discussed that all simulated storms in the storm track generator impacting Florida with hurricane strength winds are included up to a specified number of years needed for convergence based on lost costs.

Reviewed the storm track generator given in G-1.2.

Discussed that the stochastic storm set recycles historical storms' genesis location akin to a National Weather Service ensemble model.

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 statistics are derived from the simulated tracks entering specified regions.

Discussed that the storm track model generates storm tracks and intensities on the basis of historical storm conditions and motions, and that the initial seeds for the storms are derived from the HURDAT2 dataset.

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

Discussed that technical documents and published research are available on the Florida Public Hurricane Loss Model project website: https://fphlm.cs.fiu.edu.

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 maximum winds across the Form M-2 maps.

Pre-Visit Letter

7. M-4.9, Figure 28, page 142: Provide comparisons of modeled and observed landfall windfields for Hurricane Irma (2017) and Hurricane Michael (2018).

   Discussed that the modeling team did not have access to H*Wind analyses for Hurricanes Irma (2017) and Michael (2018), and that wind swaths from the model are compared with observed station data and other observations.

   Discussed that the H*Wind analyses are a good tool for analyzing winds over water.

   Reviewed comparison of observed versus modeled peak gust winds for Hurricane Michael (2018).

   Reviewed comparisons of observed versus modeled peak gust winds for Hurricane Irma (2017) in southern Florida and northern Florida.

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 modeling-organization-specific research that was internally developed for the wind model.

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

   Discussed the modeling-organization-specific research for deriving roughness distributions.

   Reviewed the Axe (2004) Master's Thesis describing the upstream fetch weighting methodology.

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

   Reviewed maps of surface roughness.

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

   Reviewed illustrations of the equilibrium layer and internal boundary layer methodology used to correct surface winds for terrain conditions.

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.

   Discussed that no changes have been made since the current accepted model to the LaborDay03 (1935) and NoName09 (1945) hurricane parameters.

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.

   Reviewed the comparisons provided in M-4.9.

   See PVL #7.

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

   Reviewed the vertical variation of winds as given in M-4.3.

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

   Discussed that far-field pressure is assumed to be 1013mb.

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.

   Reviewed the uncertainty in the conversion of the modeled slab layer winds to the 10-meter surface winds as given in M-4.12.

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

    Discussed the 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.

   Reviewed the overland decay rates as given in M-5.1 and 3.

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

   Reviewed the transition from over land to over water as given in M-5.2, G-1.2, and Powell et al. (2005).

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

   Reviewed comparisons of observed versus modeled maximum sustained surface winds as a function of time for Hurricane Frances (2004) and Hurricane Charley (2004) given in Figure 30.

   Reviewed comparisons of observed versus modeled maximum sustained surface winds as a function of time for Hurricane Jeanne (2004) over open terrain, Hurricane Katrina (2005) over open terrain, and Hurricane Wilma (2005) over water given in Figure 31.

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 maps of Hurricane Charley (2004), Hurricane Michael (2018), and Hurricane Ian (2022) winds and surface roughness at landfall.

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.

Pre-Visit Letter

8. M-6.4, page 151: Provide a response to the revised disclosure provided in the 2023 Hurricane Standards Report of Activities Q&As on September 12, 2024, i.e., "Describe the dependencies among characteristics (i.e., model output) in the windfield component and how they are represented by the hurricane model."

   Reviewed a revised response to M-6.4 which will be included in the final revised submission document.

   Reviewed the dependencies of the output variables on the storm parameters discussed in M-6.4, G-1.2, and Powell et al. (2005).

Audit

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

   Reviewed plot of mean windspeeds as a function of roughness lengths.

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

   Reviewed the relationship between pressure and Rmax as given in M-2.4.

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

   Reviewed the mathematical dependence of the windfield as a function of distance to center as given in G-1.2 and Powell et al. (2005).

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

   Discussed that the windfield asymmetry increases with translation speed, which was demonstrated with an animation.

   Discussed that there was no change in modeling the asymmetry of the windfield.

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

   Discussed that the model windfields have been validated against H*Wind observations.

   Discussed how modeled radii are derived from HURDAT2 data.

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

   Reviewed a time-evolving contour animation of the Hurricane Ian (2022) windfield.

STATISTICAL HURRICANE STANDARDS
Chris Nachtsheim, 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.

Pre-Visit Letter

9. S-1.1, Tables 10 and 11, pages 158-159: Explain how these tables were compiled. Discuss what other recent hurricanes and results have been obtained.

   Reviewed Tables 10 and 11 and how they were compiled. Discussed that the tables show the comparison of modeled to observed winds in two different ways, with Table 11 showing the root mean square errors with the same number of ZIP Codes as in Table 10.

   Discussed that no validations have been performed for other hurricanes due to no longer having the H*Wind surface wind analysis package.

   Reviewed the comparison of modeled and observed wind swaths of maximum sustained marine surface winds for Hurricane Andrew (1992) in Figure 32.

10. S-1.1, page 160: Explain how the 3-mph positive bias is determined.

    Discussed that the 3.3mph average difference in modeled versus observed windspeeds is a weighted average of the >56mph Model Threshold column in Table 10 across all storms and ZIP Codes.

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.

   Reviewed the characterization of uncertainty provided in S-1.1 for windspeed and in S-1.3 for hurricane annual loss, probable maximum loss levels, and loss costs.

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.

   Discussed that no regression analyses were performed in the model.

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.

Discussed the results of the sensitivity analyses submitted in 2010, and that 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.

Discussed the results of the uncertainty analyses submitted in 2010, and that 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.

   Discussed that the error in the county level loss costs induced by the sampling process was quantified by computing the standard errors for the county level loss costs using 62,000 years of simulation resulting in standard errors less than 2.5% of the average loss cost estimates for all Florida counties.

   Reviewed the calculation for the standard error estimates.

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.

Pre-Visit Letter

11. S-5.1, Table 14, pages 175-177 and Figure 39, page 178: Explain how Figure 39 was constructed with data from Table 14. Note that the Figure 39 caption should indicate Personal Residential.

    Discussed Table 14 regarding personal residential losses for different hurricanes and different insurance companies, and Figure 39, a scatter plot of the actual losses versus modeled losses with no aggregation or separation.

    Reviewed an updated Figure 39 that will be included in the final revised submission document.

12. S-5.1, Table 15, page 179: Provide statistical validation tests for actual versus modeled losses.

    Discussed that Table 15 provides 12 cases of actual versus modeled commercial residential losses. Reviewed paired t-test results with a t-statistic of 2.12, degrees of freedom of 11, and a *p*-value of 0.0571 that is to be included in the final submission document.

    Discussed that the statistical tests provided insufficient evidence of a difference between mean actual and modeled losses at a significance level of 0.05.

13. Form S-4, pages 579-580: Explain the relatively large differences in modeled versus company actual loss/exposure for Appurtenants in Comparison #1 and for Hurricane Michael (2018) in Comparison #2.

Discussed that appurtenant structure damage is not derived from building damage, and that three equations were developed to determine the appurtenant structure damage ratio as a function of windspeed.

Discussed that one equation predicts damage for structures highly susceptible to wind damage, the second predicts damage for structures moderately susceptible to wind damage, and the third predicts damage for structures that are only slightly affected by winds.

Discussed that the type of appurtenant structure is not typically provided in an insurance portfolio, and that a distribution of the three types is assumed and validated against the claims data.

Reviewed an updated Comparison #2 in Form S-4. Discussed that the claims data have issues that cannot be resolved at this time. Discussed the details of the issues.

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 a revised Comparison #2 in Form S-4 for Hurricane Irma (2017) for a different insurance company that will be included in the final submission document.

Reviewed revised Tables 14 and 15 updating the modeled personal residential and commercial residential losses for Hurricane Irma (2017), and the revised associated scatter plots in Figures 39 and 40 that will be included in the final submission document.

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

Discussed that the Florida Public Hurricane Loss Model Version 8.3 was used to generate all modeled historical losses.

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

Discussed that the data used for model validation are the claims and exposure data obtained from the Florida Office of Insurance Regulation (OIR).

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

Discussed the issues in the hurricane loss and exposure data for Hurricane Michael (2018) that cannot be resolved at this time.

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

Discussed that the data from different insurance companies used for validation are Hurricane Andrew (1992), Hurricane Erin (1995), Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Jeanne (2004), Hurricane Dennis (2005), Hurricane Wilma (2005), Hurricane Katrina (2005), Hurricane Matthew (2016), Hurricane Irma (2017), and Hurricane Michael (2018).

Discussed that the data for Hurricanes Matthew (2016), Irma (2017), and Michael (2018) were obtained from the OIR data call in 2023.

Discussed that loss data for Hurricane Ian (2022) are not included in the statistical analyses due to the lack of a sufficient body of claims data for Ian.

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

Discussed that modeled hurricane parameters are based on observations where available.

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 there are no departures from the windfields used in the model.

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 model utilizes structure, contents, time element, and appurtenant structures coverage to calculate losses across personal residential and commercial residential policy types.

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

Discussed that demand surge is considered in modeled losses for validation.

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

Discussed that flood losses are not modeled, and that flood losses cannot be separated from the claims data if included in the data.

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 no data are excluded from validation.

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

Discussed issues with the Hurricane Michael (2018) claims data.

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

Discussed that there are no assumptions.

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

Reviewed the 95% confidence intervals for the mean difference of actual and modeled losses for personal residential and commercial residential based on the validation data.

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.

Discussed that the results in Form S-4 show actual losses.

Discussed that the modeled losses for Hurricane Irma (2017) changed due to a change in the wind radii for Irma.

Reviewed the revised Comparison #2 for different insurance companies by different hurricanes changing the losses and company for Hurricane Irma (2017).

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 comparisons of modeled versus actual losses given in S-5.1, Tables 14 and 15 and Figures 39 and 40. Discussed that the tables and figures were revised to update the Hurricane Irma (2017) modeled losses.

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,

   Reviewed the justifications provided in Form S-3.

   b. The effect of by-passing hurricanes,

   Discussed that bypassing hurricanes are included.

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

   Discussed that multiple landfalls are included.

   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 that there are no other exposure assumptions.

VULNERABILITY HURRICANE STANDARDS
Chris Jones, 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.

Pre-Visit Letter

14. V-1.9, page 250: Explain how the 2-year window in which ASCE 7-16 was used for residential design affects the vulnerability model.

    Discussed that the engineering team developed a prototype variant of the current strong model to reflect the Florida Building Code (FBC) 2020 adoption of ASCE 7-16 which increased the pressure on roof components making the roof system more vulnerable.

    Reviewed Bedwell et al. (2022) on "The Influence of ASCE 7-16 Wind Load Provisions on a Vulnerability Model of Florida Residential Construction."

    Discussed that FBC 2023 adopted ASCE 7-22 which removed the increase in roof loads. Implementation of the strong model variant was discontinued.

15. Form V-1, pages 591-594: Explain the changes in Part A and Part B from the current accepted model.

    Reviewed a corrected Form V-1 that will be included in the final submission document. Discussed how the editorial error happened in the original Form V-1, and ways to prevent this type of error from happening in the future.

    Reviewed that there were no changes in Part A from the current accepted model Form V-1 for personal residential reference structures, and that there were small changes in Part A for commercial residential reference structures and for all reference structures combined.

    Reviewed the differences in Part B from the current accepted model.

    Discussed that there were no changes in the vulnerability models. Discussed that differences from the current accepted model relate to changes in the ZIP Code data and boundaries resulting in ZIP Code roughness changes.

Audit

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

    Discussed that no modifications were made to the building vulnerability component since the current accepted model.

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

    Discussed that no modifications were made to the building vulnerability component since 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 breakdown of insurance company exposure data provided in V-1.3.

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 breakdown of insurance company hurricane claims data provided in V-1.3 and a table of the data in the above requested format.

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 uncertainties in the wood frame, masonry, and manufactured homes vulnerability functions are the result of uncertainties in the quantification of physical exterior building damage and the resulting interior damage. Reviewed the methodology provided in G-1.2 and V-1.6.

Discussed that the process is the same for wood frame, masonry, and manufactured homes.

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 there is no uncertainty attached to the meteorology component for windspeeds of individual hurricanes at a given location.

   Discussed that windspeed is treated as a random variable with a normal distribution in the vulnerability model. Reviewed an example of the randomized windspeed.

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.

   Reviewed the claims data provided in V-1.3 and V-1.11.

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

   Discussed that the building vulnerability functions are developed based on an engineering component approach and engineering judgement, and are not the result of an empirical regression against historical data.

   Discussed that historical claims data are used to calibrate and validate the models, and that since the claims data have issues and vary from storm to storm and company to company, a goodness-of-fit is not sought between the models and the variety of empirical data.

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

   Reviewed the information provided in V-1.7 and the corresponding references in G-1.6.

   Discussed the different field and laboratory data used.

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

    Reviewed the information provided in G-1.2, Vulnerability Component, and V-1.5-9 and 11.

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

    See Audit 8 and 10.

    Reviewed the information provided in G-1.2, Vulnerability Component, and V-1.3, 5, and 11.

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

    Reviewed the information provided in V-1.7 and the corresponding references in G-1.6.

    Reviewed samples of post 2004 season damage surveys.

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

    Reviewed the information provided in G-1.2, Vulnerability Component, and V-1.5-9 and 11.

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 examples of weak, medium, and strong vulnerability functions for one-story, two-story, and three-story commercial low-rise buildings, and for one-story and two-story personal residential buildings across windspeed bands.

    Reviewed examples of vulnerability functions for wood frame, masonry, and other structures across windspeed bands.

    Reviewed comparison of manufactured homes vulnerability curves by HUD Wind Zones across windspeeds.

    Reviewed plot of the appurtenant structures damage ratio across windspeed bands. Discussed why the appurtenant structures damage ratio is capped at 40%.

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

    Reviewed in the information in G-1.2, Vulnerability Component, and V-1.9.

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

    Reviewed the process for incorporating insurance company claims data in V-1.4.

    Discussed that no new insurance claims data was incorporated in the model under review.

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 the process used by the modeling team for analyzing claims data. See V-1.3.

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

    Discussed that neither the vulnerability model nor the financial model have a specified percentage of damage above which the model assumes a total loss.

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

    Discussed that the law and ordinance requirements are an integral part of the vulnerability functions. See G-1.2, Vulnerability Component, A-1.4, and A-3.5.

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

    Reviewed comparisons of masonry and wood frame building structure and appurtenant structure vulnerability functions in Figures 45 and 46.

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

    Reviewed comparison of appurtenant structure vulnerability functions with insurance company claims data in Figure 47.

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.

Audit

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

   Discussed that no modifications were made to the contents vulnerability component since 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 no modifications were made to the contents vulnerability component since 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.

   Discussed that no modifications were made to the contents vulnerability component since the current accepted model.

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

   Reviewed two examples of three weak, medium, and strong contents vulnerability functions for one-story, two-story, and three-story commercial low-rise buildings, and for one-story and two-story personal residential buildings across windspeed bands.

Reviewed comparison of manufactured homes contents vulnerability curves by HUD Wind Zones across windspeeds.

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

   Discussed that the contents vulnerability functions are developed based on an engineering component approach and engineering judgement, and are not the result of an empirical regression against historical data.

   Discussed that historical claims data are used to calibrate and validate the models, and that since the claims data have issues and vary from storm to storm and company to company, a goodness-of-fit is not sought between the models and the variety of empirical data.

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 contents for personal residential is extrapolated from building damage, and that contents for commercial residential is treated similarly to interior damage. Discussed that uncertainties for contents are the same as for buildings.

   Reviewed the information in V-2.4 and 6.

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

   Reviewed the information in V-2.3, 5 and 6.

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

   Reviewed the information in V-2.2, 3, 5 and 6.

   Discussed that contents vulnerability functions were developed in the same manner as the building vulnerability functions, are independent of the building vulnerability functions, and calculate losses using separate vulnerability matrices.

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

   Reviewed the information in V-2.2, 3, 5 and 6.

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

    See V-1, Audits 3 and 4.

    Discussed that the same combination of hurricane claims data and rational engineering analysis was used for building and contents.

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

    Reviewed the information in V-1.14 and V-2.6.

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.

Pre-Visit Letter

16. V-3.D, page 281: Text states the model includes flood and hurricane storm surge in time element losses. Justify this inclusion in a hurricane wind model.

    Discussed that there is not enough information to differentiate between the effects of infrastructure damage from wind and from water in time-related-losses in the claims data, and that it is a reasonable assumption that time-element claims data used for calibration and validation of the model include the effects from both wind and storm surge.

Audit

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

    Discussed that no modifications were made to the time element vulnerability component since the current accepted model.

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

   Discussed that no modifications were made to the time element vulnerability component since 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 time element will be reviewed.

   Discussed that no modifications were made to the time element vulnerability component since the current accepted model.

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

   Reviewed examples of weak, medium, and strong time element vulnerability functions for one-story and two-story personal residential buildings across windspeed bands.

   Reviewed comparison of time element vulnerability curves for manufactured homes by HUD Wind Zones across windspeeds.

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 that time element is a function of building damage, and that the uncertainties for time element are the same as for buildings.

   See V-1, Audit 5 and V-3.4.

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

   Reviewed the information in V-3.2-6.

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

   Discussed that the time element vulnerability functions are developed from an engineering component approach and are not the result of an empirical regression against historical data.

   Discussed that historical claims data are used to calibrate and validate the models, and that since the claims data have issues and vary from storm to storm and company to company, a goodness-of-fit is not sought between the models and the variety of empirical data.

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

   Reviewed the information in V-3.2-5.

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.

   See V-1, Audits 3 and 4.

   Discussed that the same combination of hurricane claims data and rational engineering analysis was used for building and time element.

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.

Audit

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

   Discussed that no modifications were made to the mitigated building vulnerability component since the current accepted model.

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

   Discussed that no modifications were made to the mitigated building vulnerability component since the current accepted model.

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

   Discussed that special software is not used to calculate the impact of hurricane mitigations.

   Reviewed the information in V-4.5-8.

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 that the only changes in Form V-5 are in the loss costs which are due to changes in the meteorological component of the model.

   Discussed that the time-stepping application of mitigation measures leads to the negative values in Form V-2 for Nailing of Deck 8d where the roof attachment fails at windspeeds before the roof sheathing comes into play.

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 effects of combining hurricane mitigations as given in Forms V-2 and V-3.

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 no changes were made to the mitigated building vulnerability component since the current accepted model.

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 claims data do not provide information on mitigation measures.

   Reviewed the information in V-4.5-8.

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,
   b. The association between roof age and year built, including assumptions,
   c. Variation in roof age assumptions (e.g., by region or ZIP Code), and
   d. The impact of roof age on loss costs.

   Reviewed the information provided in G-1.2, Tables 1 and 2.

   Reviewed Pinelli et al. (2012) on "Life-Cycle Assessment of Personal Residential Roof Decking and Cover under Hurricane Threat."

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.

   Discussed that no changes were made to the mitigated building vulnerability component since the current accepted model.

   Reviewed the combination of mitigation measures in Forms V-2 and V-3.

   Reviewed the information in V-4.6.

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 the information in V-4.5-9 and Form V-4.

ACTUARIAL HURRICANE STANDARDS
Steve Kolk, 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

17. A-1.B, page 300:
    a. Provide a sample report of changes to an original input file arising from missing user input values.

    Reviewed a sample report with the original data summary and the changes made to the data for mapping or assigning values for unknown inputs.

    b. Explain how missing (unknown) input values (pages 302-313) are treated versus their known input value treatment.

    Discussed that unknown values can be imputed using county-level statistics for most attributes, and that policies missing certain attributes are processed using weighted vulnerability matrices. Discussed that policies missing key attributes are not modeled.

    Reviewed the treatment of unknown values outlined in Table 32, Input Data Pre-Processing.

c. Provide example calculations of one default factor that changed, or if no default factors changed, explain why not.

Discussed that the only default factor used is for sliding glass doors for commercial residential exposures, and if unknown, that the exposure is assumed to have sliding glass doors.

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

Discussed that the default value has not changed from the current accepted model.

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.

   Reviewed the rules and procedures for checking accuracy of input data in A-1.7.

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.

   Reviewed the general format of an output report given in A-1.5. Reviewed a sample output report in PVL #17.

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 the input forms given in A-1.4.

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.

   Discussed that the model is executed exclusively by the Computer Science team at FIU.

   Discussed that an insurance company or model user has no options beyond those provided in the “Input Record Specifications.”

   Discussed that all model runs are acceptable for a Florida rate filing.

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

18. A-2.B, page 318: Provide a copy of the document, "FPHLM Procedure to distinguish wind-related hurricane losses from other peril losses."

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

19. A-2.1, page 318: Discuss the different wind cutoffs (30 mph) in this disclosure and the response to A-2.A (50 mph).

    Discussed that the 30-mph reference is an open terrain windspeed which is the threshold for including bypassing hurricanes in damage calculations.

    Discussed that the vulnerability matrices columns represent roughness adjusted 3-second gust windspeeds at 10-meters, from 50 – 250 mph in 5-mph bands.

    Discussed the difference between A-2.A requesting minimum damaging windspeeds and A-2.B.1 requesting the criteria for including or excluding storms from loss costs and probable maximum loss (PML) calculations.

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 the model produces losses by insured coverage for stochastic hurricanes that generate windspeeds of 50 mph or higher in at least one Florida ZIP Code.

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 damages are calculated for non-landfalling hurricanes with point of closest approach to the coast and open terrain winds greater than 30 mph in at least one Florida ZIP Code.

   Discussed that damages are calculated for landfalling hurricanes in neighboring regions E or F with open terrain winds greater than 30 mph in at least one Florida ZIP Code.

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 damage from concurrent or preceding flood or storm surge is not considered in the calculation of modeled losses.

   Discussed that the model assumes that wind is the only cause of loss from each hurricane and calculates losses directly based on windspeed and expected damage from that windspeed.

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

   See PVL #18.

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

20. A-3.B, page 319:
    a. Provide a sample calculation of the partial loss costs for appurtenant structures.

    Reviewed an example of building, appurtenant structure, contents, and time element partial loss for a hypothetical policy.

    b. Describe how this partial loss cost analysis of appurtenant structures differs from building loss cost analysis.

    Discussed that appurtenant structures and building losses are calculated using separate vulnerability matrices applied to separate insured values by coverage.

    Discussed that appurtenant structures and building losses are subject to separate coverage limits.

    c. Explain how actuarial analysis of contents data differs from analysis of building data, highlighting the ways the partial loss cost analysis of contents differs from building loss cost analysis.

    Discussed that contents and building losses are calculated using separate vulnerability matrices applied to separate insured values by coverage.

    Discussed that contents and building losses are modified by separate demand surge factors and are subject to separate coverage limits.

Audit

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

   Discussed that damages are estimated by coverage for each storm in the stochastic set, and that the resulting damages are adjusted for policy limits, deductibles, and demand surge.

   Discussed that the damages are aggregated across all storms to calculate the annual average loss cost per $1,000 of exposure.

   Reviewed the methodology to produced loss costs by coverage provided in A-3.1.

   Reviewed the modeled appurtenant structures damage ratio versus claims data from Hurricanes Charley (2004), Ivan (2004), and Wilma (2005). Discussed that the weighted appurtenant structures damage ratio is based on engineering judgement.

   Discussed the communications between the engineering team and the actuarial team.

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 a provision for law and ordinance (L&O) coverage is embedded in the vulnerability matrices.

   Discussed that whenever roof damage exceeds 25%, that roof damage is set at 100% to reflect the impact of law and ordinance (Florida Building Code).

   Discussed that the model assumes that mandated roof replacement is the primary source of L&O loss and that there is no application of the 25% or 50% limitation which helps to offset any understatement from this omission.

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

21. A-4.1, pages 324-325: 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 in the stochastic set descending from the Top Event which showed agreement to Form A-8.

22. A-4.5, page 327: Provide additional details about the validation of hurricane loss costs and hurricane probable maximum loss levels.

    Discussed that actual insured losses from past storms were compared to the model's insured loss estimates for various portfolios of policies. Reviewed the details for the comparisons given in S-5.

    Discussed that no adjustments were made for economic inflation in the validation process.

Discussed that the model applies damage ratios to each policy's insured value at the time of the historical storm and validates against the actual insured losses from that storm.

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 estimates only direct insured losses for residential property.

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

   Discussed that PML levels are estimated as quantiles of the ordered set of losses produced by the stochastic set of storms.

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

   Reviewed the uncertainty in loss costs and PMLs given in S-1.3, and the 95% confidence intervals.

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.

   Reviewed the information provided in A-4.3.

   Discussed that demand surge factors are applied to modeled losses for each storm, and that the factors vary by coverage and region and depend on the total modeled losses for a storm prior to the application of demand surge.

   Reviewed the average and maximum values of demand surge factors for the stochastic set using the 2017 FHCF exposure dataset.

   Discussed that the structure factors were based on the Marshall & Swift construction cost indices for Florida ZIP Codes, and were derived by considering the difference between the projected and actual index values following historical storms.

   Discussed that contents and time element factors are functions of the building factor for each storm.

Discussed that Hurricanes Erin (1995), Opal (1995), Georges (1998), Irene (1999), Charley (2004), Frances (2004), Jeanne (2004), Katrina (2005), Rita (2005), and Wilma (2005) were included in the demand surge derivation. Discussed that attempts to add other storms have proved to be difficult due to the index being sold to CoreLogic. Discussed that the modeling team is working to purchase indices for Hurricanes Matthew (2016), Irma (2017), Ian (2022), and Nicole (2022).

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

Discussed that there is no explicit adjustment for economic inflation in the modeled loss costs or PMLs, and that the impact of economic inflation on insured values will lead to higher modeled losses over time.

Discussed that any effect of social inflation on claims costs is reflected in the vulnerability assumptions and will be updated when the damage assumptions are calibrated against more recent claims data.

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

Discussed that modeled wind losses are determined without consideration of preceding or concurrent flood damage, and that exposures are assumed to be undamaged before each storm with only wind damage estimated.

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 the model does not use claims data to develop mathematical depictions.

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

   Discussed that actual insured losses from past storms are compared to the model's insured loss estimates for various portfolios of policies.

   Reviewed the information given in S-5.

3. Treatment of annual hurricane deductibles will be reviewed.

   Reviewed the information given in A-5.3.

   Reviewed implementation of annual hurricane deductibles in the source code.

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.

   Reviewed comparison to the current acceptable model of changes in the deductible relativities from the new stochastic storm set. Discussed that the percentage change is higher for the larger deductibles where the relativity is small.

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

23. Form A-1: Explain the following.
    a. Broward County, ZIP Code 33310: Explain why loss costs for this ZIP Code increase about 20% (Frame +23.7%, Masonry +17.9%, Mobile Homes +25.7%) when all other Broward County loss costs changes are decreases.

    b. Escambia County, Zip Code 32512: Explain why loss costs for this ZIP Code increase about 40% (Frame +45.9%, Masonry +37.4%, Mobile Homes +43.0%%) when all other Escambia County loss costs changes are single-digit percent changes.

    Discussed that the ZIP Codes with the negative changes in Form A-1 are point ZIP Codes; 33310 is a post office in Flagler Village, and 32512 is the Pensacola Naval Hospital.

24. Form A-2, page 382: Explain why the loss values using the 2023 FHCF Exposure Data are identical for Hurricanes NoName01-1926 and GreatMiami07-1926 ($5,831,591,937).

    Discussed that the loss value for GreatMiami07-1926 in the November 6, 2024, submission was an error. Reviewed a corrected Form A-2. See CI-4, Audit 12 for details on the cause of the error.

    Reviewed a further revised Form A-2 and a revised Form A-3 to update the modeled losses for Hurricane Irma (2017) after including Irma wind radii data in the Model Base Hurricane Set.

25. Form A-5, page 459: Explain why the largest percent changes for $0 Deductible Output Ranges are to Manufactured Homes (+7.65% statewide, maximum region change in the South +11.65%) while all other coverage forms/regions show single-digit percent changes.

    Discussed that manufactured homes were impacted more than other construction types by the HURDAT2 storm updates, and that manufactured homes were not impacted by the year of hurricane/retrofitting update.

Audit

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

   Discussed that there were no modifications to the financial component of the hurricane model from 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.

   Discussed that the PMLs in Form A-8 are quantiles of the ordered set of modeled losses produced by the stochastic set of storms.

   Reviewed a table of counties with losses over $1B from the top event on an occurrence basis.

   Discussed that the top event on an annual aggregate basis includes the top event on the occurrence basis along with two smaller events.

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 events underlying Form A-8 are the stochastic set of storms.

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

   Reviewed the Form A-1 maps by ZIP Code in Appendix B.

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

   Reviewed the Form A-1 maps by ZIP Code in Appendix B.

   Discussed that the maps show lower loss costs for inland ZIP Codes as compared to coastal.

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.

   Reviewed a sample for the deductible test used to verify the loss cost relationship in Form A-6.

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.

   Discussed that no anomalies were produced by the deductible, policy form, and number of stories tests.

   Reviewed the reasons for the anomalies produced by the coverage, year built, and building strength tests.

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

   Reviewed the changes to the zero deductible output ranges compared to the current accepted model: a 4.2% increase due to updated HURDAT2 which affects the probability distributions used in the storm track generator, and a 3.5% decrease to additional exposures qualifying for retrofitted vulnerabilities.

   Discussed that the updates to the ZIP Code database affected the population-weighted centroids, roughness, and distance to the coast, with the loss cost impact being less than one-tenth of one percent.

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

   Discussed that the loss costs in Form A-4 are county averages, and that the distribution of exposures can vary significantly among construction types and lead to average loss costs that appear to violate logical relationship to risk requirements. Discussed that Form A-6 was created to specifically address this problem by holding all exposure characteristics fixed except for the characteristic being tested.

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

    Reviewed the methodology for the calculation of uncertainty intervals.

COMPUTER/INFORMATION HURRICANE STANDARDS
Paul Fishwick, 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.

Pre-Visit Letter

26. CI-1: Discuss process improvements in inter-team communication. Discuss process improvements in using Subversion (SVN) version control for all files among teams developing software.

    Discussed the strengthening of communication channels through regular project meetings along with emails and phone conversations to ensure continuous and effective collaboration across the modeling teams.

    Discussed the enhancing of documentation quality through requirements documentation including comprehensive technical details. Discussed that all equations and formulas are clearly defined with explanations of terms and variables, and that flowcharts adhere to standardized formatting to prevent misinterpretation.

    Discussed the improvement in validation processes, including collaboration between modeling teams and programmers reinforced through systematic audits of implementation results.

    Discussed that thorough reviews of model results, both before and after changes, helps to confirm accuracy and proper execution.

    Discussed the standardized file organization with clear folder structures established by file type and purpose to reduce confusion and enhance accessibility.

    Discussed the controlled access to shared resources. Discussed the use of user-specific credentials and training.

    Discussed the version management discipline with enforced check-out/check-in procedures with descriptive commit messages to ensure traceable and collaborative editing.

    Discussed the streamlined steps for assembling final submission deliverables from verified, up-to-date sources using SVN for version control.

    Discussed that ongoing oversight is conducted through regular audits, activity reviews, and feedback loops to ensure compliance and continuous refinement of SVN-based practices.

Audit

1. The central repositories will be reviewed.

    Discussed the use of Apache Subversion (SVN) as the primary document repository software. Discussed that documents are version controlled and history is maintained.

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

   Reviewed the documentation, including equations and variable mapping, for calculating the hurricane windfield model.

   Reviewed the documentation with variable mapping for the application of annual hurricane deductibles.

   Reviewed the documentation for the procedure to assign a vulnerability matrix to a personal residential policy.

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 engineering and development 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 along with requirement specifications are created and stored separately from the source code.

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 summary of changes for the model updates since the current accepted model.

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.

   Traced the hurricane model updates through 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.

   Discussed that requirements for each module, database, and data file are precisely documented.

   Discussed that documentation is maintained as part of a large-scale project management requirement, including quality assurance documents, system hardware and software specification documents, training documents, model maintenance documents, test documents, and user manuals.

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

   Reviewed the model updates requirements documentation that was revised during the audit.

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 a revised flowchart for the Monte Carlo simulation procedure to predict building damage.

   Reviewed a revised flowchart for the procedure to create personal residential building vulnerability matrices.

   Reviewed a revised flowchart for exterior and interior damage assessment for mid- and high-rise buildings.

   Reviewed other flowcharts throughout the audit.

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

   Reviewed the model components interface specifications throughout the audit.

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

Reviewed examples of schemata throughout the audit.

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

Reviewed the network diagram.

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 workflow of the different modeling teams involved in development of the hurricane model.

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 hurricane model is implemented on a single platform.

Discussed that the computer platform is designed to accommodate future hookups of additional sub-components or enhancements.

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

Reviewed the flowchart standards followed for the hurricane model.

Discussed that flowcharts are created using ISO 5807, BPMN, and UML 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:

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

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

J. ***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.

Audit

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

   Reviewed implementation of the gradient wind using the *Holland B* pressure profile parameter and calculating hurricane surface winds.

   Reviewed the source code for creating vulnerability matrix files.

   Reviewed the vulnerability matrix file that corresponds to a vulnerability curve for a medium strength structure with a gable roof.

   Reviewed implementation of annual hurricane deductibles.

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 coding guidelines.

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

   Reviewed the procedure related to creating and verifying datasets.

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

   Reviewed the process used to ensure traceability among model components.

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 all source code is under source control and revision software.

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

   Reviewed the table of software components.

Reviewed the code count table for the storm track generator model.

Reviewed the code count table for producing the vulnerability matrix table.

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

   Reviewed the equation mapping table for the windfield model.

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 the model is designed and operates on a computing cluster of 60 servers interconnected by network routers with 2,412 total CPU cores and 509TB of storage.

   Discussed that the backend probabilistic calculations are coded in C++, and that the system uses a PostgreSQL database that runs on a Linux server.

   Discussed that there are minimal end-user workstation requirements, and that any current version of Internet Explorer, Firefox, Chrome, or Safari running on a currently supported version of Windows, Mac, or Linux should deliver an optimal user experience.

10. Network organization implementation will be reviewed.

    Reviewed the flow diagram of the hurricane model in Figure 14.

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.

    Reviewed test plans and test case documentation.

    Reviewed the code and data update plans.

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

    Discussed that Form A-2 is generated using an automated script, and that a difference between certain event names in the model output and the form template required manual adjustments leading to an error in Form A-2 where the losses for NoName01-1926 and GreatMiami07-1926 were duplicated.

Discussed that a script has been created to update storm names in the model outputs ensuring consistency with the names in the form template, and that the user manual has been revised to instruct users to confirm that storm names are correctly updated and aligned with the form template before generating the form.

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.

Audit

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

   Reviewed procedures for unit conversion.

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.

   Software was reviewed for sufficient logical assertions and flag-triggered statements.

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

   Testing software was reviewed for different types of testing, including unit testing and regression testing.

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

   Reviewed documentation of test cases.

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.

   Examples of testing and verification were reviewed.

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

   Reviewed a flowchart of testing processes.

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

   Reviewed the data verification process.

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

   Reviewed the procedure to ensure complete and accurate implementation of model updates.

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.

   Discussed that the user interface consists of a web-based application hosted on a Tomcat web application server.

   Reviewed the configuration interface with pre-defined parameters.

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

   Reviewed the hurricane model setup guide.

   Reviewed guidelines for command line interfaces (CLI).

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

   Reviewed the decision process documentation specifying the logic of interface option selections.

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 procedures for reviewing and maintaining code and data.

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

   Reviewed the hurricane model revision and management plan.

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, Audit 1.

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

   Discussed that SVN is used to identify and describe modifications to code, data, and documentation.

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

   Reviewed the list of all hurricane model revisions since the initial submission.

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

   Reviewed the model 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 procedures for security of code, data, and documentation.

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 security procedures for hurricane model access and off-site procedures in the event of a catastrophe.

3. Security aspects of each platform will be reviewed.

   Discussed that the hurricane model runs on only one platform.

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

   Reviewed network security documentation and procedures for network integrity assurance.

   Discussed that there have been no known security breaches of the flood model implementation.

   Discussed that both physical and electronic backups of the servers are performed daily.

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 that AI was not used in the development of the Florida Public Hurricane Loss Model Version 8.3. and that the model does not currently utilize AI in its core processes.

Discussed potential AI use cases for future model submissions which will be discussed with the Commission during the June 2025 meeting to review the model for acceptability:

1. Anomaly Detection – using AI models to flag unusual patterns or outliers in exposure data
2. Code Refactoring – leveraging AI techniques, such as code optimization and automated refactoring, to improve software code
3. Automated Data Validation – employing large language models (LLMs) or AI agents to automatically identify data inconsistencies, missing values, or formatting issues