Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report

2021 Hurricane Standards

Hurricane Florence

Florida Public Hurricane Loss Model

Florida International University

On-Site Review

March 6 – 9, 2023

On March 6-9, 2023, the Professional Team conducted an on-site review of the Florida Public Hurricane Loss Model (FPHLM) Version 8.2 at Florida International University. The following individuals participated in the review.

FPHLM

Bachir Annane, Ph.D., Senior Research Associate III, CIMAS/HRD
Odai Athamneh, Computer Science Student, University of Missouri-Kansas City
Shu-Ching Chen, Ph.D., Professor, Director, Data Science and Analytics Innovation Center (dSAIC), University of Missouri-Kansas City
Sriramrao Chennamaneni, Computer Science Student, Florida International University
Steve Cocke, Ph.D., Scholar/Scientist, Department of Meteorology and COAPS, Florida State University
Gail Flannery, FCAS, MAAA, Consulting Actuary, AMI Risk Consultants, Inc., Miami, Florida
Kurt Gurley, Ph.D., Professor, Department of Civil and Coastal Engineering, College of Engineering, University of Florida
Shahid Hamid, Ph.D., CFA, Professor and Chairman Department of Finance, College of Business, Florida International University
Golam Kibria, Ph.D., Professor, Mathematics and Statistics, College of Arts and Sciences, Florida International University
Siddhi Lanke, Computer Science Student, Florida International University
Daniel Martinez, Technical Editor, Florida International University
Jean-Paul Pinelli, Ph.D., P.E., Professor, Civil Engineering Department, Florida Institute of Technology
Galen Schick, Computer Science Student, University of Missouri-Kansas City
Dongwook Shin, Ph.D., Associate Research Scientist, Florida State University
Mei-Ling Shyu, Professor, Electrical and Computer Engineering, Division of Energy, Matter and Systems, School of Science and Engineering, University of Missouri-Kansas City
Joeffrey Somera, Consulting Actuary, AMI Risk Consultants, Inc., Miami, Florida
Yudong Tao, Ph.D., Consultant, Meta
Tianyi Wang, Ph.D. Candidate, Computer Science, Florida International University
Wensong Wu, Ph.D., Associate Professor, Statistics, Florida International University

Professional Team

Jimmy Booth, Ph.D., Meteorology
Paul Fishwick, Ph.D., Computer/Information
Mark Johnson, Ph.D., Statistics, Team Leader
Steve Kolk, ACAS, MAAA, Actuarial, observer
Stu Mathewson, FCAS, MAAA, Actuarial
Greg McLellan, P.E., Vulnerability
Ryan McMahan, Ph.D., Computer/Information, observer
Ben Addleton, Staff, observer
Donna Sirmons, Staff

The Professional Team began the review with an opening briefing and introductions were made. The audit continued with a review of each standards section.

During the Commission meeting to review the model for acceptability under the 2021 Hurricane Standards, FIU is to present the following information as specified on page 64 of the *Hurricane Standards Report of Activities as of November 1, 2021*:

1. Detailed information and discussion of Forms V-3 and V-5,
2. Discussion on how the model addresses the impacts of the claims environment, the legal environment, and litigation effects on modeled losses, and
3. Detailed information and discussion of relativities in Form A-6.

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the January 5, 2023 meeting. The deficiencies were eliminated by the established time frame, and the modifications have been verified.

1. Non-responsive. The submission document pdf file is not bookmarked (see Report of Activities, page 56).

2. G-1.B, Figure 1, page 20: Incomplete. Right-hand side of flowchart is missing text.

3. G-1.D, page 21: Non-responsive. Response is a restatement of the standard (see Report of Activities, page 56).

4. G-1.E, page 21: Non-responsive. Response is a subset of words from the standard, and the sentence is unclear (see Report of Activities, page 56).

5. Form G-5, page 566: Incomplete. No signature or date provided.

6. M-2.9, Figure 26, page 143: Unclear. The legend has six categories, but four distinct colors are used. It is not apparent whether the middle bar is for FPHLM 2019 or FPHLM 2021.

7. V-1.2, Figure 43, page 202: Unclear. Flowchart does not conform to flowchart standards.

8. V-1.2, Figure 44, page 203: Unclear. Flowchart does not conform to flowchart standards.

9. V-1.3, page 206: Incomplete. Amount of hurricane loss and dollar exposure are not provided.

10. V-1.6, page 239: Unclear. Final sentence under Summary truncated.

11. Forms V-3 and V-5. Incomplete. Forms are to be included in a submission appendix (see Report of Activities, page 57).

12. Form A-4, page 356: Non-responsive. Responses regarding ZIP Codes are not provided for D and E.

Professional Team Pre-Visit Letter

The Professional Team's pre-visit letter questions 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 2021 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 review that is not given below or discussed during an upcoming conference call to be held if requested by FIU. One goal of the 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.

The Professional Team will also consider material provided in response to the deficiencies designated by the Florida Commission on Hurricane Loss Projection Methodology (Commission) during the January 5, 2023, meeting.

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 a detailed explanation of new or extensively updated material related to the model followed by a review of each hurricane standard commencing with responses to the pre-visit letter questions followed by responses to the audit items for each hurricane standard in the *Hurricane Standards Report of Activities as of November 1, 2021*.

If changes have been made in any part of the model or the modeling process from the descriptions provided in the original November 7, 2022, 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, 2021,* for more details on materials to be presented and provided to the Professional Team. Particular attention should be paid to the requirements under Presentation of Materials. These requirements are reproduced at the conclusion of this letter.

In addition to the 6 items listed under Presentation of Materials, provide upon arrival of the Professional Team, and before the review can officially commence, printed copies of:

1. Flowchart standard documents if internally developed, or references to published standards, and

2. Software engineering practice and coding guidelines if internally developed, or references to published standards.

While the Report of Activities specifies 6 printed copies, an additional SBA staff member and additional Professional Team members will be in attendance. Please have available 9 printed copies of all materials.

The pre-visit questions are grouped by hurricane standards sections.

Editorial Items

Editorial items in the submission documentation were noted by the Professional Team in the pre-visit letter for correction prior to the start of the on-site review in order to facilitate efficiency during the review and to avoid last minute edits. Additional editorial items identified during the review are also included below.

The Professional Team reviewed the following corrections to be included in the revised submission to be provided to the Commission no later than 10 days prior to the meeting to review the model for acceptability.

1. Track change formatting issue corrected for Figures and Table numbering.
2. All equations numbered sequentially and in a consistent style throughout the document.
3. Table of Contents: Form A-7 title updated to 2021 Hurricane Standards Report of Activities (ROA).
4. List of Figures: Figures 17, 18, 19, and 25 titles corrected to correspond to Figures 17, 18, 19, and 25 titles as given in the submission.
5. Appendix list corrected.
6. G-1.2: Figure 1 revised. Windfield model text revised for consistency on the use of polar coordinates. (Table 3) corrected to remove split across three lines of text. The revised description of the Interior and Contents Damage material from the current accepted model revised for clarity and to complete the description. Sentence “Differentiation…” corrected to be a section heading in bold. Numerous other instances throughout the submission were revised for consistency for text or section headings. Use of EIDR revised for consistency. Clarified single or double subscripts for Bldg and Bld equation variables.
7. G-1.3: Figure 15 model flow diagram revised for clarity.
8. G-1.6: References updated, revised for consistency in style, and placed in the appropriate sections.
9. G-2.2A, Table 9: Tenure years updated for Dr. Chen, Dr. Shyu, and Daniel Martinez. Hary Barahona spelling corrected. New employees listed under 2B added to Table 9. Joeffrey Somera added.
10. G-2.4-9: Wording for disclosures updated to 2021 ROA.

11. G-4: Standard wording updated to 2021 ROA.
12. M-1: Standard numbering updated to 2021 ROA.
13. S-1.4: Table 12 title corrected. Table 14 corrected.
14. S-5: Standard and Disclosure 1 wording updated to 2021 ROA.
15. Form S-4: Formatting of instructions corrected for clarity.
16. Form S-5: Explicit units for entries in the form provided.
17. V-1.2: Reference to Disclosure 1 in last paragraph corrected.
18. V-1.6: Paragraph under Exterior Component Uncertainty reformatted for consistency. "Inputs variables" corrected.
19. V-1.9: Last paragraph updated
20. V-1.11: Disclosure number corrected.
21. V-1.14: First two items after where and equation (14) revised for clarity.
22. V-1.14: First two items after where and equation (15) revised for clarity.
23. V-1.14: First item after where and equation (17) revised for clarity.
24. V-2.3: Second sentence of first paragraph under Commercial residential low-rise model corrected.
25. V-2.5: Last sentence on page corrected.
26. V-3.3: Second paragraph below Commercial Residential corrected.
27. V-3.5: Disclosure and standard for G specified.
28. V-4.A: Standard wording updated to 2021 ROA.
29. V-4.2: Model version updated.
30. Form V-1: Form V-1.C and V-1.D formatting corrected.
31. Form V-3: Form V-3.B response revised to match the corrected response to V-3.A.
32. Form V-5: Form V-5.C revised to correct "theses."
33. All Vulnerability Forms placed in consecutive Appendices; Table of Contents updated.
34. A-2.A: Response revised to not be a restatement of the standard.
35. A-2.B: Response revised to not be a restatement of the standard.
36. A-4.E: Revised to correct "based on and analysis."
37. A-5.C: Disclosure reference corrected.
38. Form A-6.B and I: Hyperlinks added for Appendix G.
39. All Actuarial Forms placed in consecutive Appendices; Table of Contents updated.
40. Appendix V: Added acronyms omitted from the list.
41. Form M-3: Form Central Pressure range values corrected.

GENERAL HURRICANE STANDARDS – Mark Johnson, Leader

G-1 Scope of the Hurricane Model and Its Implementation*

*(*Significant Revision)*

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

B. A documented process shall be maintained to assure continual agreement and correct correspondence of databases, data files, and computer source code to presentation materials, scientific and 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 and shall be located in centralized, model-level file areas.

D. A subset of the forms shall be produced through an automated procedure or procedures as indicated in the form instructions.

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

Audit

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

2. All primary scientific and technical literature that describes the underlying hurricane model theory and implementation (where applicable) should be available for review in hard copy or electronic form. Modeling-organization-specific publications cited must be available for review in hard copy or electronic form.

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

4. Items specified in Hurricane Standard G-1.C will be reviewed as part of the Computer/ Information Hurricane Standards.

5. Maps, databases, and data files relevant to the submission will be reviewed.

6. Justification for the vintage of data, code, and scientific and technical literature used will be reviewed.

7. The following information related to changes in the hurricane model, since the initial submission for each subsequent revision of the submission, will be reviewed.
   A. Hurricane model changes:
      1. A summary description of changes that affect, or are believed to affect, the personal or commercial residential hurricane loss costs or hurricane probable maximum loss levels,
      2. A list of all other changes, and
      3. The rationale for each change.
   B. Percentage difference in average annual zero deductible statewide hurricane loss costs based on the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named *"hlpm2017c.zip"* for:
      1. All changes combined, and
      2. Each individual hurricane model component and subcomponent change.
   C. For any modifications to Form A-4, Hurricane Output Ranges, since the initial submission, a newly completed Form A-5, Percentage Change in Hurricane Output Ranges, with:
      1. The initial submission as the baseline for computing the percentage changes, and
      2. Any intermediate revisions as the baseline for computing the percentage changes.
   D. Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide hurricane loss costs based on the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named *"hlpm2017c.zip"* for each hurricane model component change, between:
      1. The currently accepted hurricane model and the revised hurricane model,
      2. The initial submission and the revised submission, and
      3. Any intermediate revisions and the revised submission.

Pre-Visit Letter

1. G-1.B, page 19: Explain the coordination across personnel.

2. G-1.2, page 28: In the last paragraph, the text states a 6.0 sm resolution land-sea mask. The current accepted model states a 0.6 sm resolution land-sea mask. Explain this discrepancy between model versions. Also, sm should be added to the acronyms list.

3. G-1.2, page 39: Explain how Additional Living Expenses are determined in the model.

4. G-1.2, Vulnerability Matrices, page 40: The 4th paragraph states, "For example, if 30% of the roof cover is damaged…" and then proceeds to calculate the value of the home lost as a result of the 30% roof cover damage. Explain how this is rectified in the model given the Florida Building Code 25% threshold for roof replacement.

5. G-1.2, page 43: Provide Figure 10 with windspeed in mph.

6. G-1.2, page 44: Explain how the three types (slightly vulnerable, moderately vulnerable, and highly vulnerable) of appurtenant structures are determined.

7. G-1.3, Figure 15, page 67: Describe how by-passing hurricanes fit into the flowchart. Describe how hurricane tracks from genesis fit into the flowchart.

8. G-1.7, pages 111-117: Explain how interim software updates, if performed, over the past two years mesh with Standard G-1.7.

Verified: YES

Professional Team Comments:

Reviewed responses to Deficiencies noted in the General Standards.

Reviewed the coordination across personnel working in different standards sections.

Resolved the value of the resolution land-sea mask to be 6.0 statute miles rather than 0.6 statute miles as given in the current accepted model owing to an editorial issue in the document rather than an error. The resolution of the land mask did not change.

Reviewed the 30% roof cover damage example in light of the Florida Building Code 25% threshold for roof replacement. Reviewed the application of roof damage thresholds and the value used in computing the structure damage costs.

Reviewed the three types of appurtenant structures: high, moderate, and low vulnerability.

Reviewed how by-passing storms fit into the model flowchart.

Reviewed several editorial issues with the references and anticipated page changes.

G-2 Qualifications of Modeling Organization Personnel and Consultants Engaged in Development 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 (currently 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.

Audit

1. The professional vitae of personnel and consultants engaged in the development of the hurricane model and responsible for the current hurricane model and the submission will be reviewed. Background information on the professional credentials and the requisite experience of individuals providing testimonial letters in the submission will be reviewed.

2. Forms G-1, General Hurricane Standards Expert Certification; G-2, Meteorological Hurricane Standards Expert Certification; G-3, Statistical Hurricane Standards Expert Certification; G-4, Vulnerability Hurricane Standards Expert Certification; G-5, Actuarial Hurricane Standards Expert Certification; G-6, Computer/Information Hurricane Standards Expert Certification, and all independent peer reviews of the hurricane model under consideration will be reviewed. Signatories on the individual forms will be required to provide a description of their review process.

3. 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.

4. For each individual listed under Disclosure 2.A, specific information as to any consulting activities and any relationship with an insurer, reinsurer, trade association, governmental entity, consumer group, or other advocacy group within the previous four years will be reviewed.

Pre-Visit Letter

9. G-2.2B, page 123: Provide resumes of the new personnel.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- Odai Athamneh, B.S. in Computer Sciences, University of Missouri, Kansas City, MO
- Arturo Corral, B.S. in Computer Science, Florida International University, Miami, FL
- Sebastian Dolan, B.S. in Computer Science (2023), Florida International University, Miami, FL; B.S. in Biology, University of Central Florida, Orlando, FL
- Salvakam Mohan Harikrishna, M.S. in Computer Science and Engineering (2023), University of Missouri, Kansas City, MO; B.S. in Computer Science and Engineering, Sri Indu College of Engineering and Technology, Hyderabad-Telangana, India
- Saikumar Lattupalli, M.S. in Computer Science, University of Missouri, Kansas City, MO; B. Tech. in Electronics and Communication Engineering, CVR College of Engineering, Hyderabad, India
- Shivaprasad Panasam, M.S. in Computer Science, University of Missouri, Kansas City, MO; B.Tech. in Computer Science and Engineering, Kakatiya University, Warangal, Telangana, India
- Sangeetha Ramtenki, M.S. in Computer Science, University of Missouri, Kansas City, MO; B.E. in Information Technology, Chaitanya Bharathi Institute of Technology, Hyderabad, India
- Sravan Sanghi, M.S. in Computer Science (2024), University of Missouri, Kansas City, MO; B.Tech. in Electronics and Communications Engineering, Jawaharlal Nehru Technological University, Hyderabad, India
- Joeffrey Somera, B.S. in Chemical Engineering, University of the Philippines Diliman, Quezon City, Philippines
- Thanveer Sulthana, Ph.D. Candidate in Computer Science, University of Missouri, Kansas City, MO; M.S. in Computer Science, Osmania University, Hyderabad, India; B.S. in Computer Science, Deccan College of Engineering and Technology, Hyderabad, India
- Hary Usaquen, B.S. in Biomedical Engineering, Florida International University, Miami, FL

Reviewed corrections to Table 9 of professional credentials.

Reviewed the corrected and updated Expert Certification forms.

G-3 Insured Exposure Location

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.

Audit

1. Geographic displays for all ZIP Codes will be reviewed.
2. Geographic comparisons of previous to current locations of ZIP Code centroids will be reviewed.
3. Third party vendor information, if applicable, and a complete description of the process used to validate ZIP Code information will be reviewed.
4. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.
5. Examples of geocoding for complete and incomplete street addresses will be reviewed.
6. Examples of latitude-longitude to ZIP Code conversions will be reviewed.
7. Hurricane model ZIP Code-based databases will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the process for updating ZIP Codes, noting that it had not changed.

Reviewed new versus prior centroids and boundaries throughout the state.

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.

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). 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.

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

Verified: YES

Professional Team Comments:

Reviewed the theoretical soundness of the model components and detected no compensation for potential bias.

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, Editorial Review Expert Certification, that the submission has been personally reviewed and is editorially correct.

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, 2021* will be made.

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.

3. Confirmation that the submission has been reviewed by the signatories on the Expert Certification Forms G-1 through G-6 for accuracy and completeness will be assessed.
4. The modification history for submission documentation will be reviewed.

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

6. Form G-7, Editorial Review Expert Certification, will be reviewed.

Pre-Visit Letter

10. G-5, page 133: Explain the document control process with the current accepted model as a starting point through the final submission pdf file. It appears that the current submission was prepared from a variety of prior versions of the current accepted model. To illustrate consider M-2.1. The original submission for the current accepted model started the first paragraph as “Recent research…”. The tracked changed version for the current accepted model reads “Research …”. For the submission under review, the sentence has returned to “Recent research …”. More generally there have been an introduction of numerous editorial mistakes, formatting inconsistencies, and so forth that were not present in the current accepted model submission. Further examples on pages 37, 270, and 293 indicate that the final submitted pdf file was not reviewed.

Verified: YES

Professional Team Comments:

Reviewed the large increase in editorial issues compared to those found in the review of the current accepted model.

Identified breakdowns in the implementation of the process to ensure editorial correctness.

Identified weaknesses in the reviews of the submission material and particularly, the assembly of the contributions from the various section experts into a coherent, complete, and consistently formatted document. Noted issues with the pdf version.

Identified issues with the software used to construct the front matter lists.

Identified numerous corrections to be made for the tracked changed version of the document.

Discussed plans to strengthen the editorial process and the interactions and cross-checking by personnel.

Interviewed the technical editor and concluded that further training and coordination with Project Manager Shahid Hamid is needed.

Identified weaknesses with managing timelines in the production of the submission document. In particular, without strict adherence to a reasonable timeline, insufficient time will be available to adequately review the final submission for editorial correctness.

Reviewed a flowchart of a comprehensive plan for document control from genesis, through expert input, to final assembly culminating in a final review prior to submission to the Commission.

Discussed the limitations of replacing prior technical editors with one half-time graduate student in Computer Information Sciences.

Discussed plans to strengthen the oversight of editorial by the Project Manager.

METEOROLOGICAL HURRICANE STANDARDS – Jimmy Booth, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

The Base Hurricane Storm Set is the National Hurricane Center HURDAT2 as of June 10, 2021 (or later), incorporating the period 1900-2020. A model may be constructed in any scientifically sound and defensible fashion. However, annual frequencies used in hurricane model validation shall be based upon the Base Hurricane Storm Set, allowing for modifications if justified. Complete additional season increments and updates to individual historical storms that are approved by the National Hurricane Center are acceptable modifications, as are weighting and partitioning of the Base Hurricane Storm Set, if it is justified in current scientific and technical literature.

Audit

1. The modeling organization Base Hurricane Storm Set will be reviewed.

2. A flowchart illustrating how changes in the HURDAT2 database are used in the calculation of hurricane landfall distribution will be reviewed.

3. Changes to the modeling organization Base Hurricane Storm Set from the currently accepted hurricane model will be reviewed. Any modification by the modeling organization to the information contained in HURDAT2 will be reviewed.

4. Reasoning and justification underlying any short-term, long-term, or other systematic variations in annual hurricane frequencies incorporated in the hurricane model will be reviewed.

5. Modeled probabilities will be compared with observed hurricane frequency using methods documented in current scientific and technical literature. The goodness-of-fit of modeled to historical statewide and regional hurricane frequencies as provided in Form M-1, Annual Occurrence Rates, will be reviewed.

6. Form M-1, Annual Occurrence Rates, will be reviewed for consistency with Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, and Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses.

7. Comparisons of modeled probabilities and characteristics from the complete historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against the complete HURDAT2 database. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete HURDAT2 database.

Verified: YES

Professional Team Comments:

Reviewed the changes for Hurricanes Alma (1966), Inez (1966), and Gladys (1968) in the Base Hurricane Storm Set due to the ongoing HURDAT2 reanalysis project.

Discussed the process for ensuring consistency between the annual occurrence rates of Florida landfalling hurricanes in Form M-1, Form S-1, and Form A-2.

Discussed that the different numbers of events per category for the Modified Base Set in Form M-1 are due to their decisions, such as categorizing storms as either landfall or by-passing.

Discussed the process for updating the model when there are updates to HURDAT2. Reviewed the corresponding flowcharts.

Discussed the conventions used for referring to HURDAT or HURDAT2.

Discussed the issue of climate change and learned that they are discussing it, but have not addressed it with any changes to the model as yet.

M-2 Hurricane Parameters and Characteristics*

*(*Significant Revision)*

Methods for depicting all modeled hurricane parameters and characteristics, including but not limited to windspeed, radial distributions of wind and pressure, minimum central pressure, radius of maximum winds, landfall frequency, tracks, spatial and time variant windfields, and conversion factors, shall be based on information documented in current scientific and technical literature.

Audit

1. All hurricane parameters used in the hurricane model will be reviewed.

2. 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 asymmetric structure of hurricanes.

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

4. Scientific literature cited in Hurricane Standard G-1, Scope of the Hurricane Model and Its Implementation, may be reviewed to determine applicability.

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

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

Verified: YES

Professional Team Comments:

Reviewed the updated Rmax distribution, which includes storms through 2021 and changes based on updates to HURDAT2.

Reviewed comparison of historical to modeled landfall occurrence rates by category and region.

Reviewed comparison of historical landfall occurrence rates between the submitted model and the currently accepted model.

Discussed the changes in loss costs due to changes associated with updates in HURDAT2 input to their model and the updated surface roughness.

Discussed the process for generating storm tracks in the synthetic storm set.

Discussed how the synthetic model generates slow-moving storms.

Discussed the surface wind factor.

Discussed their analysis that shows that the surface wind factor is not sensitive to variability in Rmax or Vmax.

Discussed the meaning and application of their model variable “damage threshold distance," which was updated to “critical threshold distance” in the submission.

M-3 Hurricane Probability Distributions*

*(*Significant Revision)*

A. Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.

B. Modeled hurricane landfall frequency distributions shall reflect the Base Hurricane Storm 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).

C. Hurricane models shall use maximum one-minute sustained 10-meter windspeed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm 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.

Saffir-Simpson Hurricane Wind Scale

Category	Winds (mph)	Damage
1	74 – 95	Minimal
2	96 – 110	Moderate
3	111 – 129	Extensive
4	130 – 156	Extreme
5	157 or higher	Catastrophic

Audit

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

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

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

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

5. Form S-3, Distributions of Stochastic Hurricane Parameters, will be reviewed.

Verified: YES

Professional Team Comments:

Discussed that the stochastic track and intensity simulation model generates 61,000 years of track data.

Discussed that the entire stochastic set is used in their analysis; no subsetting is done.

Discussed the methodology for designating a storm as making landfall or impact in the region designated (by them) as the Keys region versus Miami versus Naples.

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.

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.

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

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

4. 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, Base Hurricane Storm Set Statewide Hurricane Losses.

5. 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.

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

7. Form M-2, Maps of Maximum Winds, will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the process for updating the surface roughness dataset. The updated street-level roughness and updated ZIP Code database resulted in changes to the population-weighted roughness and distance to coast for each ZIP Code.

Reviewed the comparison of modeled and observed landfall windfields of Hurricane Charley (2004) and Hurricane Wilma (2005).

Reviewed a plot of mean winds versus surface roughness.

Discussed the bias in modeled winds of Hurricane Charley (2004), and that the bias is on the order of the uncertainty in the observations.

Discussed the overall comparisons of their model with H*Wind, focusing on their results that there is no systematic weak bias in the modeled winds.

Discussed the approach for modeling winds above the surface.

Discussed the need for comparisons of modeled and observed winds for more recent storms, potentially using observations from multiple individual sites.

M-5 Hurricane Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

A. The hurricane over-land weakening rate methodology used by the hurricane model shall be consistent with historical records and 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.

Audit

1. The variation in over-land decay rates used in the hurricane model will be reviewed.

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

3. 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 Andrew (1992), Hurricane Jeanne (2004), and Hurricane Irma (2017) at the closest time after landfall will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed comparison of historical to modeled storm decay as a function of time for Hurricanes Charley (2004), Frances (2004), Jeanne (2004), Katrina (2005), and Wilma (2005).

Discussed the bias in the modeled maximum sustained winds for Hurricane Andrew (1992) in Figure 37.

Discussed that there are no compensating biases in other model components of Hurricane Andrew (1992) or other storms.

Reviewed the coastal transition model for transition of winds from over-water to over-land.

Reviewed plots of the surface roughness spatial distribution for Hurricane Dennis (2005).

Reviewed map of the updated surface roughness spatial distribution for Miami-Dade County.

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.

Audit

1. The logical relationship between windspeed and surface roughness will be reviewed.
2. Form M-2, Maps of Maximum Winds, will be reviewed.
3. Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, and the modeling organization sensitivity analyses will be reviewed.
4. Justification for the relationship between central pressure and radius of maximum winds will be reviewed. The relationships among intensity, Rmax, and their changes will be reviewed.
5. Justification for the variation of the asymmetry with the translation speed will be reviewed.
6. Methods (including any software) used in verifying these logical relationships will be reviewed.
7. Time-based contour animations (capable of being paused) of windfield distributions demonstrating scientifically-reasonable windfield characteristics and logical relationships will be reviewed.

Pre-Visit Letter

11. Form M-3, page 581: Explain the change in outer radii >40mph values from the current accepted model.

Verified: YES

Professional Team Comments:

Reviewed Form M-2.

Reviewed comparison between the submitted model and the current accepted model of the wind radii quartiles in Form M-3.

Discussed their finding of no apparent relationship between central pressure and radius of maximum wind in observations, except for lower central pressure values.

STATISTICAL HURRICANE STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit*

*(*Significant Revision)*

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

B. Modeled and historical results shall reflect statistical agreement using current scientific and statistical methods for the academic disciplines appropriate for the various hurricane model components or characteristics.

Audit

1. Forms S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year; S-2, Examples of Hurricane Loss Exceedance Estimates; and S-3, Distributions of Stochastic Hurricane Parameters, will be reviewed. Justification for the distributions selected, including for example, citations to published literature or analyses of specific historical data, will be reviewed. Justification for the goodness-of-fit tests used will also be reviewed.

2. 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.

3. Regression analyses performed will be reviewed, including for example 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.

Verified: YES

Professional Team Comments:

Reviewed comparison of the modeled and historical distributions.

Reviewed the Chi-square goodness-of-fit tests for landfall frequency, Holland B parameter, and Rmax distributions.

Discussed the process for running and verifying the Rmax data for the goodness-of-fit test. Discussed the process for choosing among competing maximum likelihood estimates for the Rmax data.

Discussed that for Rmax, a slightly larger domain is used than what is used for the Florida impact tracks data. This is intentional and allows for more data to use in the analysis and made it possible for the Rmax data fitting to include a storm from 2021.

S-2 Sensitivity Analysis for Hurricane Model Output

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.

Audit

1. The modeling organization's sensitivity analysis will be reviewed in detail. Statistical techniques used to perform sensitivity analysis will be reviewed. The results of the sensitivity analysis displayed in graphical format (e.g., color-coded contour plots with temporal animation) will be reviewed.

2. Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

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

S-3 Uncertainty Analysis for Hurricane Model Output

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.

Audit

1. The modeling organization uncertainty analysis will be reviewed in detail. Statistical techniques used to perform uncertainty analysis will be reviewed. The results of the uncertainty analysis displayed in graphical format (e.g., color-coded contour plots with temporal animation) will be reviewed.

2. Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Discussed that no changes were made in model methodology from the current accepted model, 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.

Audit

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

Verified: YES

Professional Team Comments:

Reviewed the methodology for determining the standard error estimate of the loss costs for each county using 61,000 years of simulation.

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) and Hurricane Michael (2018), to the extent data are available for these storms.

Audit

1. The following information for each insurer 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,
   b. The version of the hurricane model used to calculate modeled hurricane losses for each hurricane provided,
   c. A general description of the data and its source,
   d. A disclosure of any material mismatch of exposure and hurricane loss data problems, or other material consideration,
   e. The date of the exposures used for modeling and the date of the hurricane,
   f. An explanation of differences in the actual and modeled hurricane parameters,
   g. A listing 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 consideration,
   h. The type of cover 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,
   i. The treatment of demand surge or loss adjustment expenses in the actual hurricane losses or the modeled hurricane losses, and
   j. The treatment of flood losses (including hurricane storm surge losses) in the actual hurricane losses or the modeled hurricane losses.

2. The following documentation will be reviewed:
   a. Publicly available documentation referenced in the submission in hard copy or electronic form,

b. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
c. An analysis that identifies and explains anomalies observed in the validation data, and
d. User input data for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

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

4. Form S-4, Validation Comparisons, will be reviewed.

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.

Pre-Visit Letter

12. S-5.1, Table 14, pages 186-188: Some entries in this table have reverted to the values reported originally in the initial 2019 submission which, in the course of the previous audit, were changed (e.g., C with Francis, Jeanne and Katrina, N with Francis and Katrina, Q with Dennis and Katrina). On the other hand, A with Francis now uses the corrected value from the prior audit. Explain how these results came about and justify the values in the current submission.

Verified: YES

Professional Team Comments:

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

Discussed that Table 14 was not correctly updated in the initial November 2022, submission document and the underlying reasons for the error. Noted that this error was not reported prior to the on-site review nor at the opening briefing. Traced in detail how the incorrect file appeared in the initial submission and why it was not discovered in a timely fashion.

Identified some apparent anomalies in corrected Table 14 that were ultimately resolved.

Reviewed comparisons with insured loss data between the model submitted for review and the current accepted model.

Discussed that claims data for Hurricane Irma (2017) and Hurricane Michael (2018) are not included in the statistical analyses due to the claims data received thus far from these storms is incomplete.

Reviewed scatter plots of actual versus modeled losses for personal residential and commercial residential exposures.

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.

Audit

1. Form S-5, Average Annual Zero Deductible Statewide Hurricane Loss Costs – Historical versus Modeled, will be reviewed for consistency with Hurricane Standard G-1, Scope of the Hurricane Model and Its Implementation, Disclosure 7.

2. Justification for the following will be reviewed:
   a. Meteorological parameters,
   b. The effect of by-passing hurricanes,
   c. The effect of actual hurricanes that had two landfalls impacting Florida,
   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 consideration, and
   e. Exposure assumptions.

Verified: YES

Professional Team Comments:

Reviewed Form S-5 comparing historical and modeled annual average statewide loss costs.

Discussed that the differences between modeled and historical annual average statewide loss costs are due to uncertainty.

VULNERABILITY HURRICANE STANDARDS – Greg McLellan, Leader

V-1 Derivation of Building Hurricane Vulnerability Functions*

*(*Significant Revision)*

A. Development of the building hurricane vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) laboratory or field testing, (3) rational structural analysis, and (4) post-event site investigations. Any development of the building hurricane vulnerability functions based on rational structural analysis, post-event site investigations, and laboratory or field testing shall be supported by historical data.

B. The derivation 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 derivation and application of building hurricane vulnerability functions.

E. Hurricane vulnerability functions shall be separately derived 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).

Audit

1. Modifications to the building vulnerability component of the hurricane model since the currently accepted hurricane model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impacts on the building vulnerability component.

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

3. Historical data in the original form will be reviewed with explanations for any changes made and descriptions of how missing or incorrect data were handled. When historical data are used to develop building hurricane vulnerability functions, the goodness-of-fit of the data will be reviewed. Complete reports detailing loading conditions and damage states for any laboratory or field-testing data used will be reviewed. When rational structural analysis is used to develop building hurricane vulnerability functions, such analyses will be reviewed for a variety of different building construction classes. Laboratory or field tests and original post-event site investigation reports will be reviewed.

4. All scientific and technical literature, reports, and studies used in the continual development of the building hurricane vulnerability functions must be available for review in hard copy or electronic form.

5. Multiple samples of building hurricane vulnerability functions for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures will be reviewed. The magnitude of logical changes among these items for a given windspeed and validation materials will be reviewed.

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

7. Validation of the building hurricane vulnerability functions and the treatment of associated uncertainties will be reviewed.

8. Documentation and justification for the effects on the building hurricane vulnerability functions due to local and regional construction practices, and statewide and local building codes and their enforcement will be reviewed. If year of construction or geographical location of building is used as a surrogate for building code and code enforcement, complete supporting information for the number of year of construction groups used as well as the year-band and geographical regions of construction that separate particular groups will be reviewed.

9. Validation material for the disclosed minimum windspeed will be reviewed. The computer code showing the inclusion of the minimum windspeed at which damage occurs will be reviewed.

10. The breakdown of new hurricane claims data into number of policies, number of insurers, dates of hurricane loss, amount of hurricane loss, and amount of dollar exposure, separated into personal residential, commercial residential, and manufactured homes will be reviewed. Indicate whether or not the new hurricane claims datasets were incorporated into the hurricane model. Research performed and analyses on the new hurricane claims datasets and the impact on hurricane vulnerability functions will be reviewed.

11. How the claim practices of insurance companies are accounted for when hurricane claims data for those insurance companies are used to develop or to verify building hurricane vulnerability functions will be reviewed. Examples include 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, or the impact of the legal environment.

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

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

14. A plot comparing building structure and appurtenant structure hurricane vulnerability functions will be reviewed.

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

16. Form V-1, One Hypothetical Event, and the process for completing the form with respect to building damage will be reviewed.

Pre-Visit Letter

13. V-1.6, pages 234-239: Describe how uncertainties associated with building vulnerability functions are derived from wood frame and manufactured home constructions.

14. V-1.6, Interior Damage Module Uncertainty, pages 236-237: Explain and define the term "defects" as opposed to "breaches."

15. V-1.14, Treatment of wind borne missile impact damage, pages 254-255: Explain the trajectory model used to determine $B(V_{wind})$. Explain how the probability $D(V_{wind})$ is obtained.

16. V-1.14, Treatment of water infiltration in the commercial residential model, page 257: In regard to "the model applies defect densities depending on the building's strength…," explain how a defect is dependent on the building strength.

17. V-1.14, page 266: For "water penetration through component defects or pre-existing deficiencies," explain how component defects or pre-existing deficiencies are determined.

18. V-1.14, Water percolation for MHR CR, page 267: In regard to the "model assumes the percolation ρ to be 10% of the rainwater ingress…," explain how the 10% value was obtained.

Verified: YES

Professional Team Comments:

Reviewed example of the high, moderate, and low appurtenant structure vulnerability functions across windspeed bands.

Discussed that the uncertainties in the vulnerability functions for wood frame, masonry, and manufactured homes are the result of uncertainties in both the quantification of physical exterior building damage and the resulting interior damage.

Discussed that the capacities of the exterior building components are uncertain and are randomly assigned during a Monte Carlo simulation of exterior building damage. The uncertainties for commercial residential-low rise are not dependent on the type of exterior wall and apply to both masonry and wood frame structures. For personal residential, the uncertainty from exterior structure damage propagates to the interior damage for wood frame, masonry, and manufactured homes.

Discussed that “breaches” are the result of physical damage to an exterior component, as a result of a wind event providing a means of water ingress not present before the wind event. “Defects” are pathways into the building interior that pre-exist the storm event as a result of standard building practice, not damage, including installation, maintenance and the lack there of, and ageing. Water ingress through defects may initiate at lower windspeeds, while ingress through breaches initiates at higher windspeeds when damage occurs.

Reviewed the calculation for water penetration through component defects or pre-existing deficiencies. Discussed that deficiency area estimates are assigned based on the average effective air leakage areas.

Reviewed the trajectory model used to determine the impact of wind-borne debris missiles. Reviewed the probability distribution and its dependency on windspeed.

Discussed that there were no changes made to the vulnerability model from the current accepted model.

Discussed that no new claims data have been received from the Florida Office of Insurance Regulation since 2005.

Reviewed the methodology for modeling roof external pressure coefficients.

V-2 Derivation of Contents Hurricane Vulnerability Functions*

*(*Significant Revision)*

A. Development of the contents hurricane vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) tests, (3) rational engineering analysis, and (4) post-event site investigations. Any development of the contents hurricane vulnerability functions based on rational engineering analysis, post-event site investigations, and tests shall be supported by historical data.

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

Audit

1. Modifications to the contents vulnerability component of the hurricane model since the currently accepted hurricane model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impact on the contents vulnerability component.

2. Comparisons of the contents hurricane vulnerability functions with the currently accepted hurricane model will be reviewed.

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

4. To the extent that historical data are used to develop mathematical depictions of contents hurricane vulnerability functions, the goodness-of-fit of the data to fitted models will be reviewed.

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

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

7. Documentation and justification of the method of derivation and underlying data or assumptions related to contents hurricane vulnerability functions will be reviewed.

8. Validation of the contents hurricane vulnerability functions and the treatment of associated uncertainties will be reviewed.

9. Form V-1, One Hypothetical Event, and the process for completing the form with respect to contents damage will be reviewed.

Pre-Visit Letter

19. V-2.4, page 275: Provide contents hurricane vulnerability functions for wood frame, masonry, and manufactured home, one set for construction built in 1980 and one set for construction built in 2020.

Verified: YES

Professional Team Comments:

Reviewed comparison of contents vulnerability functions between 1980 and 2020 construction eras for wood frame, masonry, and manufactured homes.

V-3 Derivation of Time Element Hurricane Vulnerability Functions*

*(*Significant Revision)*

A. Development of the time element hurricane vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) tests, (3) rational engineering analysis, and (4) post-event site investigations. Any development of the time element hurricane vulnerability functions based on rational engineering analysis, post-event site investigations, and tests shall be supported by historical data.

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 historical data.

C. Time element hurricane vulnerability function derivations 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.

Audit

1. Modifications to the time element vulnerability component of the hurricane model since the currently accepted hurricane model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impact on the time element vulnerability component.

2. Comparisons of the time element hurricane vulnerability functions with the currently accepted hurricane model will be reviewed.

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

4. Documentation and justification of the method of derivation and underlying data or assumptions related to time element hurricane vulnerability functions will be reviewed.

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

6. To the extent that historical data are used to develop mathematical depictions of time element hurricane vulnerability functions, the goodness-of-fit of the data to fitted models will be reviewed.

7. Validation of the time-element hurricane vulnerability functions and the treatment of associated uncertainties will be reviewed.

8. Form V-1, One Hypothetical Event, and the process for completing the form with respect to time element loss will be reviewed.

Verified: YES

Professional Team Comments:

Discussed that time-element expenses are a function of interior damage and are assumed to cover expenses for up to one year at 20% of the building value.

Discussed that time-element expenses have been calibrated against claims data, which includes the effect of utilities disruptions.

Reviewed the relationship of time-element damage ratio to the interior damage ratio.

Reviewed scatter plot comparison of modeled and observed time-element losses.

V-4 Hurricane Mitigation Measures and Secondary Characteristics

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.

Audit

1. Modifications to hurricane mitigation measures and secondary characteristics in the hurricane model since the currently accepted hurricane model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications, and their impacts on the hurricane vulnerability functions.

2. Comparisons of hurricane mitigation measures and secondary characteristics with the currently accepted hurricane model will be reviewed.

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

4. Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage; Form V-3, Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret Item); Form V-4, Differences in Hurricane Mitigation Measures and Secondary Characteristics; and Form V-5, Differences in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret Item), will be reviewed.

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. Any variation in the change in hurricane damage over the range of windspeeds for individual hurricane mitigation measures and secondary characteristics will be reviewed. Historical data, scientific and technical literature, insurance company hurricane claims data, analysis or judgment based on fundamental engineering principles used to support the assumptions and implementation of the hurricane mitigation measures and secondary characteristics will be reviewed.

6. The treatment of roof age will be reviewed.

7. 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.

8. Hurricane mitigation measures and secondary characteristics used by the hurricane model, whether or not referenced in Form V-2, Hurricane Mitigation Measures, Range of Changes in Damage, and Form V-3, Hurricane Mitigation Measures, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret Item), will be reviewed for theoretical soundness and reasonability.

Verified: YES

Professional Team Comments:

Reviewed Forms V-2, V-3, V-4, and V-5.

Discussed that hurricane mitigation and secondary characteristics have not been modified since the current accepted model.

ACTUARIAL HURRICANE STANDARDS – Stu Mathewson, Leader

A-1 Hurricane Model Input Data and Output Reports*

*(*Significant Revision)*

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.

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.

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.

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.

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

Pre-Visit Letter

20. A-1.3, page 309: Discuss the changes in the methods used to distinguish among policy types.

21. A-1.5, page 322: Discuss the changes in the output report.

Verified: YES

Professional Team Comments:

Discussed that there was no change in the methods used to distinguish among policy types.

Discussed that the output report has not changed substantially, and that the description was revised to improve the description in the submission.

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.

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.

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.

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).

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

Pre-Visit Letter

22. A-2.B, page 326: Provide a copy of the documented procedure for distinguishing wind-related hurricane losses from other peril losses.

Verified: YES

Professional Team Comments:

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

A-3 Hurricane Coverages*

*(*Significant Revision)*

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.

Audit

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

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

Pre-Visit Letter

23. A-3.1-4, pages 327-330: Show a calculation of loss costs and probable maximum loss levels for the minimum Frame Owners loss costs in Form A-1 (i.e., ZIP Code 32046 in Nassau County).

24. A-3.5, page 330: Explain how the model handles the statutory 25% and 50% Law and Ordinance coverages.

Verified: YES

Professional Team Comments:

Reviewed a calculation of frame-owners loss costs in Form A-1 for ZIP Code 32046 in Nassau County.

Discussed how the model handles policies with and without law and ordinance coverage.

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-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.

Audit

1. How the hurricane model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, economic inflation, and any criteria other than direct property insurance claim payments will be reviewed.

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

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

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.

5. How the hurricane model accounts for economic inflation associated with past insurance experience will be reviewed.

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

7. All referenced scientific and technical literature will be reviewed, in hard copy or electronic form, to determine applicability.

Pre-Visit Letter

25. A-4.1, page 332: 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.

26. A-4, Audit items 1 and 5: Explain how economic inflation with regards to the claims environment, the legal environment, and litigation effects are modeled.

Verified: YES

Professional Team Comments:

Reviewed the top 1,000 years of hurricane activity sorted by aggregate loss corresponding to Form A-8.

Discussed that no economic or social inflation from any source is modeled and how the inflation issue will be considered in the near future.

A-5 Hurricane Policy Conditions*

*(*Significant Revision)*

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.

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.

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

3. Treatment of annual deductibles will be reviewed.

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

Verified: YES

Professional Team Comments:

Discussed how insurance claims data are used to validate the model.

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,***
4. ***northern counties versus southern counties, and***
5. ***newer construction versus older construction.***

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

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.

Audit

1. The data and methods used for hurricane probable maximum loss levels for Form A-8, Hurricane Probable Maximum Loss for Florida, will be reviewed. The hurricane associated with the Top Events will be reviewed.

2. The frequency distribution and the individual event severity distribution, or information about the formulation of events, underlying Form A-8, Hurricane Probable Maximum Loss for Florida, will be reviewed.

3. All referenced scientific and technical literature will be reviewed, in hard copy or electronic form, to determine applicability.

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

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

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, Hurricane Loss Outputs and Logical Relationships to Risk, will be reviewed. Forms A-1, Zero Deductible Personal Residential Hurricane Loss Costs by ZIP Code; A-2, Base Hurricane Storm Set Statewide Hurricane Losses; A-3, Hurricane Losses; A-6, Logical Relationships to Hurricane Risk (Trade Secret Item); and A-7, Percentage Change in Logical Relationships to Hurricane Risk, will be reviewed to assess coverage relationships.

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.

8. Forms A-4, Hurricane Output Ranges, and A-5, Percentage Change in Hurricane Output Ranges, will be reviewed, including geographical representations of the data where applicable.

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

10. Form A-4, Hurricane Output Ranges, will be reviewed to ensure appropriate relativities among deductibles, coverages, and construction types.

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

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

Pre-Visit Letter

27. A-6.10, page 344: Explain the details of the calculation of the uncertainty intervals.

28. Form A-1: Explain the changes in ZIP Codes 32346, 32815, 34429 (MH), 33039, 34286, 34288, 32083, 32445, and 32702.

29. Form A-1: Explain the changes in ZIP Codes 32403, 33944, 32455, 32961, 32302, 32314, 32315, and 32316 compared to other ZIP Codes in the county.

30. Form A-1: Explain the inconsistencies of changes between Owners and Manufactured Homes in ZIP Codes 32648, 32099, 32227, and 32228.

31. Form A-2, pages 428-431: Explain the changes from the current accepted model for Hurricanes NoName04-1912, Agnes-1972, Ike-2008, and Georges-1998.

32. Form A-4, 0% Deductible, pages 479-488: Explain the reversal in loss costs where Frame is less than Masonry:
    Owners: Gulf Average, Pasco Average, St. Johns Average
    Renters: Brevard Average, Calhoun Average, Wakulla Average
    Condo Unit: Brevard Average, Duval Average, Wakulla Average.

33. Form A-5, page 500: Explain the regional changes (e.g., Panhandle versus South Florida) in the loss costs in Form A-4, compared to the current accepted model.

34. Form A-7, pages 546-556: Reconcile the statewide changes shown in Form A-7 with Standard A-6.16 (page 347), which shows a personal residential decrease of 4.2%.

35. Form A-8, Figure 126, page 396: Explain the increases in losses for higher return periods, compared to the current accepted model.

36. Form A-8, page 558: Explain the decreases in Number of Hurricanes for the bottom four rows in Part A, compared to the current accepted model.

Verified: YES

Professional Team Comments:

Reviewed the methodology for calculating the uncertainty intervals in Form A-8.

Reviewed the changes in Form A-1 from the current accepted model in specific ZIP Codes located in Wakulla, Brevard, Citrus, Miami-Dade, Sarasota, Union, Jackson, and Lake Counties.

Reviewed comparisons of losses within a county for Form A-1 ZIP Codes in Bay, Glades, Holmes, and Indian River Counties.

Discussed the process for ensuring that the correct version of modeled loss costs are used for comparisons between the submitted model and the current accepted version.

Reviewed the changes in Form A-2 from the current accepted model for Hurricanes NoName04-1912, Agnes-1972, Ike-2008, and Georges-1998.

Discussed the loss costs in Form A-4 where frame loss costs are less than masonry loss costs, and the underlying reasons for the results.

Discussed the regional changes in Form A-4 compared to the current accepted model.

Reviewed Form A-6 and the graphical reasonableness checks performed to verify the individual loss cost relationships.

Resolved the anomalies in Form A-6 for year built and building strength.

Discussed that retrofitting is “turned off” when completing Forms A-6 and A-7. Discussed the methodology for classifying retrofitted structures.

Discussed the decrease in annual loss for the higher return periods in Form A-8 compared to the current accepted model. Discussed that the drop in the number of hurricanes at the high-end of annual losses led to longer return periods in Form A-8.C.

COMPUTER/INFORMATION HURRICANE STANDARDS – Paul Fishwick, Leader

CI-1 Hurricane Model Documentation

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. A primary document repository shall be maintained, containing or referencing a complete set of documentation specifying the hurricane model structure, detailed software description, and functionality. Documentation shall be indicative of current model development and software engineering practices.

C. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) 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 currently 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.

Audit

1. The primary document repository, containing or referencing full documentation of the software in either electronic or physical form, and its maintenance process will be reviewed.

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

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

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

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

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

7. The tables specified in Hurricane Standard CI-1.D that contain the items listed in Hurricane Standard G-1, Scope of the Hurricane Model and Its Implementation, Disclosure 7 will be reviewed. The tables should contain the item number in the first column. The remaining five columns should contain specific document or file references for affected components or data relating to the following Computer/Information Hurricane Standards: CI-2, Hurricane Model Requirements; CI-3, Hurricane Model Organization and Component Design; CI-4, Hurricane Model Implementation; CI-5, Hurricane Model Verification; and CI-7, Hurricane Model Maintenance and Revision.

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

Pre-Visit Letter

37. CI-1.B, page 398: Relate the primary binder table of contents with the response to Standard G-1.7 (pages 111-117) by demonstrating individual table item compliance with Computer/Information Standards CI-1 through CI-8.

38. CI-1.D, page 399: Provide the table required by Standard CI-1, Audit item 7.

39. CI-1.F, page 399: Provide the list of all externally acquired hurricane model-specific software and data assets as described and required by Standard CI-1, Audit item 6.

Verified: YES

Professional Team Comments:

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

Reviewed the table of model changes as required by CI-1.D. Discussed how the table is to be completed demonstrating each model change compliance for the Computer/Information Standards.

Discussed the use of Apache Subversion (SVN) for storing code, data files, and documentation.

Reviewed the version control and history of the submission document located within SVN.

Reviewed the SVN Computer File Storage Policy.

CI-2 Hurricane Model Requirements

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.

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.

Pre-Visit Letter

40. CI-2, page 400: Provide requirements documentation that specifically relates to each model change identified in Standard G-1.7 (page 111).

Verified: YES

Professional Team Comments:

Reviewed software requirements documentation for updates made in the model under review.

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.

Audit

1. The following will be reviewed:
   a. Detailed control and data flowcharts, completely and sufficiently labeled for each component,
   b. Interface specifications for all components in the hurricane model,
   c. Documentation for schemas for all data files, along with field type definitions,
   d. Each network flowchart including components, sub-component flowcharts, arcs, and labels,
   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
   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.

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

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

Verified: YES

Professional Team Comments:

Reviewed flowchart for processing changes in HURDAT2 data.

Reviewed flowchart of process to assure agreement and correct correspondence of databases, data files, and computer source code.

Reviewed flowchart for the wind-borne missile trajectory model.

Discussed that flowcharts are created using ISO 5807 and BPMN standards.

Reviewed the policy and flowchart for SVN computer file storage of code files, data files, documentation, spreadsheets, modeled results, and the submission document.

Reviewed flowchart for manual and automatic verification.

CI-4 Hurricane Model Implementation*

*(*Significant Revision)*

A. A complete procedure of coding guidelines consistent with accepted software engineering practices shall be maintained.

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., flowcharts) down to the code 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, Scope of the Hurricane Model and Its Implementation, Disclosure 7 and Audit 7:

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

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

H. Hurricane model code and data shall be accompanied by documented maintenance, testing, and update plans with their schedules. The vintage of the code and data shall be justified.

Audit

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

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.

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

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

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.

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

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

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

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

10. Network organization implementation will be reviewed.

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

Pre-Visit Letter

41. CI-4.H, page 403: Provide examples of documentation.

Verified: YES

Professional Team Comments:

Reviewed implementation and variable mapping for the wind-borne missile trajectory model.

Reviewed subject matter expert documentation for the wind-borne missile trajectory model with list of equations, variable names and definitions, and variable mapping for the corresponding equations.

Reviewed code count tables for the storm track module and the windfield model.

Reviewed the coding guidelines.

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.***

Audit

1. Procedures for unit conversion verification will be reviewed.

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.

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

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

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.

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

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

Pre-Visit Letter

42. CI-5, pages 405-407: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1.7 (page 111).

Verified: YES

Professional Team Comments:

Reviewed the code and data maintenance, update, and testing plan.

Discussed the verification procedures for the HURDAT2 data update.

Discussed no change to the testing software used for unit testing.

Reviewed the flowchart defining the processes used for manual and automatic verification.

CI-6 Human-Computer Interaction*

*(*New Hurricane Standard)*

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 rate filing, interface options shall be limited to those options found acceptable by the Commission.

Audit

1. External and internal user interfaces will be reviewed.

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

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

Pre-Visit Letter

43. CI-6.C, page 409: Provide and explain the Florida rate filing interface.

Verified: YES

Professional Team Comments:

Discussed that the FPHLM team has run the model for approximately thirty clients in the insurance industry. The clients provide the input data to FIU for the model runs.

Discussed that all users of the model are members of the Computer Science team, and that clients do not run the model itself.

Discussed the training process for model users. Reviewed the Florida Office of Insurance Regulation Processing Model Setup Guide, which is part of the Florida rate filing training material for the Computer Science student model users.

Reviewed an updated Training Plan.

Reviewed the Florida rate filing interface and configuration file directory. Reviewed the configuration outline file containing a description of each pre-defined parameter.

Reviewed an example of the configuration interface with pre-defined parameters for the current acceptable model.

Reviewed a training video on the command line interface for Florida rate filings.

CI-7 Hurricane Model Maintenance and 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 residential hurricane loss cost or hurricane probable maximum loss level shall result in a new hurricane model version identification.

C. Tracking software shall be used to identify and describe all errors, as well as modifications to code, data, and documentation.

D. 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.

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.

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

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

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

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

Pre-Visit Letter

44. CI-7.D, page 411: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed the model version history documentation. Discussed that there have been no changes in the versioning method.

CI-8 Hurricane Model Security

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.

Audit

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

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.

3. Security aspects of each platform will be reviewed.

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

Verified: YES

Professional Team Comments:

Reviewed the security policy and procedures.

Reviewed the process for ensuring security of code, data, and documentation in the event of a disaster.