Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report

2021 Hurricane Standards

Hurricane Florence

Verisk

On-Site Review: March 20 – 23, 2023

Additional Verification Review: November 2 & 3, 2023

On March 20-23, 2023, the Professional Team conducted an on-site review of the Verisk Hurricane Model for the United States Version 2.0.0 as implemented in Touchstone® 2022A. The following individuals participated in the review.

Verisk

C. Arunkumar, Senior Model QA Analyst
Siddhartha Kumar Arya, Information Security Manager
Sarah Bobby, Ph.D., Principal Engineer, Research and Modeling
Julia Borman, Ph.D., Manager, Consulting and Client Services
Nicholas Brewer, Senior Risk Consultant, Consulting and Client Services
Robert Cabeca, External Independent Peer Reviewer
Muralidhar Chittapragada, Senior Principal Engineer
Igor Cizeli, Senior Scientist
Dennis Costello, Senior Product Manager
Suryanarayana Datla, Vice President, Research
Anamitra Dhar, Senior QA Engineer
Phaninath Dheram, Senior Manager, Software Development
Thomas Diamond, Principal User Experience Designer
Carol Friedland, Ph.D., P.E., C.F.M., External Independent Peer Reviewer
Andreea Gavrilescu, Risk Consultant, Consulting and Client Services
Srimanta Ghosh, QA Manager
Stacey Gotham, FCAS, MAAA, CEEM, Senior Actuary
Isabelle Grenier, Ph.D., Scientist, Research and Modeling
Anthony Hanson, Director of Analytics
Aditya Jinna, Manager, Software Development
Tim Johnson, Ph.D., Principal Engineer and Senior Manager, Research and Modeling
Mohan Kandulapati, Senior QA Engineer
Emma Kaplan, Manager QA
Mohammad Muzzaffar Khan, Model QA Analyst
Vladimir Kireyev, Director of Software Development
Aaron Knox, Senior Analyst, Data Management
Viswa Kokkonda, Lead, Software Development
Sylvie Lorsolo, Ph.D., Principal Scientist and Senior Manager
Jianjun Luo, Ph.D., Principal Engineer and Senior Manager
Manoj Medarametla, Principal Software Engineer, Software
Asha Prabhu, Senior Software Engineer, Software Development
Karthik Ramanathan, Ph.D., Assistant Vice President, Principal Engineer
Thomas Renault, Senior Analyst, Extreme Event Solutions
Indumathi Sagyari, Team Lead, Software
Scott Sperling, CCM, Manager Quality Assurance
Steve Straight, Senior Manager
Apoorv Srivastav, Senior Model QA Analyst
Jeff Strong, Ph.D., Scientist
Ashwin Thillai, Senior Core QA Associate
Srinivas Thoudoju, Senior Software Engineer
Susan Tolwinski-Ward, Ph.D., Principal Scientist and Senior Manager, Research and Modeling
Rafal Wojcik, Ph.D., Director

Eric Uhlhorn, Ph.D., Principal Scientist
Ramesh Ummati, Senior Principal Engineer
Ivelin Zvezdov, Assistant Vice President, Research and Modeling

Professional Team
Jimmy Booth, Ph.D., Meteorology, virtually
Paul Fishwick, Ph.D., Computer/Information
Mark Johnson, Ph.D., Statistics, Team Leader
Stu Mathewson, FCAS, MAAA, Actuarial
Greg McLellan, P.E., Vulnerability
Blake Tullis, Ph.D., Hydrology and Hydraulics, observer
Donna Sirmons, Staff

The Professional Team began the review with an opening briefing and introductions were made. Verisk provided a general overview of the model changes and their impact on loss costs, corrections made for the deficiencies, and other editorial changes made to the submission.

The audit continued with a review of each standards section.

*****Additional Verification Review – November 2 & 3, 2023*****

On June 27, 2023, Verisk notified the Commission that discrepancies were found between the model version reviewed by the Professional Team during the March 20-23, 2023, on-site review and the current, running version of the model.

On September 6, 2023, Verisk submitted a revised submission. The platform was renamed Touchstone 2023A, and Forms S-2, S-4, S-5, A-1, A-2, A-3, A-4, A-6, and A-8 all had loss changes. Forms A-5 and A-7 were reproduced as required using the current acceptable model as a baseline and using the initial submission as a baseline.

A subset of the Professional Team completed an additional verification review on November 2 & 3, 2023, focusing on the implementation of financial module updates in the software which led to the discrepancies in the model. The Professional Team reviewed in detail the nature of the discrepancies, the revisions to the model, when and how the discrepancies were discovered, why the discrepancies occurred, how the discrepancies were corrected and tested, future proofing plans to mitigate against a recurrence, revisions to the submission documentation, and all relevant standards.

The following individuals participated in the additional verification review.

Verisk
Julia Borman, Ph.D., Director, Consulting and Client Services
Nicholas Brewer, Senior Risk Consultant, Consulting and Client Services
Robert Cabeca, External Independent Peer Reviewer
Suryanarayana Datla, Vice President, Research

Nazanin Firouzbakht, Verisk Regulatory Team, Observer
Srimanta Ghosh, QA Manager
Stacey Gotham, FCAS, MAAA, CEEM, Senior Actuary
Isabelle Grenier, Ph.D., Scientist, Research and Modeling
Rohit Jain, Principal Database Engineer
Aditya Jinna, Senior Manager, Software Development
Emma Kaplan, Manager QA
Connor King, Risk Analyst
Vladimir Kireyev, Director of Software Development
Asha Prabhu, Senior Software Engineer, Software Development
Karthik Ramanathan, Ph.D., Vice President, Principal Engineer
Christopher Reilly, Risk Analyst
Indumathi Sagyari, Team Lead, Software
Scott Sperling, CCM, Manager Quality Assurance
Steve Straight, Senior Manager
Apoorv Srivastav, Senior Model QA Analyst
Jeff Strong, Ph.D., Scientist
Ashwin Thillai, Senior Core QA Associate
Srinivas Thoudoju, Senior Software Engineer
Susan Tolwinski-Ward, Ph.D., Principal Scientist and Senior Manager, Research and Modeling
Rafal Wojcik, Ph.D., Director
Eric Uhlhorn, Ph.D., Principal Scientist
Ramesh Ummati, Senior Principal Engineer
Ivelin Zvezdov, Assistant Vice President, Research and Modeling

Professional Team

Paul Fishwick, Ph.D., Computer/Information
Mark Johnson, Ph.D., Statistics, Team Leader
Stu Mathewson, FCAS, MAAA, Actuarial
Donna Sirmons, Staff

All standards are verified by the Professional Team.

The Professional Team recommends that Verisk present to the Commission during the trade secret session the redesign of the financial module, the implementation discrepancies in Touchstone 2022A that led to the revisions in Touchstone 2023A, and future-proofing to catch implementation errors at an earlier stage.

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. V-1.3, pages 130-131: Incomplete. Table 10 does not give breakdown of data into number of policies, amount of hurricane loss, and amount of dollar exposure.

2. A-3.A, page 162: Incomplete. The response does not mention law and ordinance, nor does the cited disclosure 1.

3. CI-4.H, page 198: Incomplete. Vintage of code and data is not justified.

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 Verisk'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 Verisk. 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. Verisk 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 October 25, 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, additional Professional Team and Commission members will be in attendance. Please have available 7 printed copies of all materials.

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

September 26, 2023: After reviewing the 2023-09-06 revised submission in response to the reported discrepancies found in the model version presented and reviewed by the Professional Team during the March 2023 on-site review, the Professional Team has prepared questions for the additional verification review to be held on November 2 & 3, 2023. The new pre-visit letter questions have been added in blue text at the end of the previous pre-visit letter questions under the applicable standards group starting with number 201. The page numbers in the new questions refer to the 2023-09-06 track changes submission document.

A subset of the Professional Team will be participating in the additional verification review. Please have available 4 printed copies of all relevant materials upon arrival of the Professional Team.

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. Page numbers below correspond to the initial October 25, 2022 submission document.

1. G-1.6, page 21: Demuth et al. (2006) reference separated from DeMaria reference. Page 22: Year corrected for Gilbreth and Gilbreth reference. Reference moved under Computer Information Standards.

Page 25: Actuarial references updated to remove duplicate ASOP 23 and to add additional references.

2. G-1.7, page 31: Last bullet under Building Vulnerability Component revised to remove contradiction with V-1.1.
3. G-1.7, pages 32-36: Figures 4-8 updated.
4. G-2.2B, page 60: S. Srinivasan and I. Zvezdov added as new employees.
5. G-3.1, page 69: ZIP Code database ZipAll2020_Output updated.
6. M-2, page 78: Bosart 1979 reference corrected.
7. M-4.7, page 90: Second paragraph edited for clarity."
8. M-4.7, pages 96-98: Figures 13-15 captions edited for clarity.
9. S-1.2, page 111: Figure 20 caption edited for clarity.
10. S-1.3, page 106: Disclosure wording updated to the 2021 Hurricane Standards Report of Activities (ROA).
11. S-6, page 123: Modeled AAL revised to be consistent with the value given in Form S-5 (page 262).
12. V-1.9, page 135: Disclosure reference corrected.
13. V-1.11, page 137: Disclosure reference corrected.
14. CI-3, Figure 43, page 185: Discrepancies spelling corrected.
15. CI-3.B, page 195: Standard wording updated to 2021 ROA.
16. CI-7, Figure 55, page 222: Revised for missing arrowheads.
17. Form A-4, page 292: Table 44 title corrected.
18. Form A-7.D, page 315: Notional input file name corrected.
19. Appendix 6, page 334: Title revised for consistency.
20. Appendix 7, page 381: Reference to FCHLPM flowchart standards corrected to Verisk flowchart standards.
21. Appendix 10, pages 421-423: Added acronyms omitted from the list.

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 14: Explain the coordination across personnel.

2. G-1.3, Figure 2, page 20: Describe how by-passing hurricanes fit into the flowchart. Describe how hurricane tracks from genesis fit into the flowchart.

3. G-1.7, pages 30-37: Explain how interim software updates, if performed, over the past two years mesh with Standard G-1.7.

4. G-1.7, Financial Module Updates, page 31: Provide details on how the research of Wojcik et al. has been implemented in the Financial Module updates.

5. G-1.7, Figure 5, page 33: Explain the high percentage change in Nassau County versus Duval County.

6. G-1.7, Figure 6, page 34: Explain the negative percent changes in Monroe, Collier, Lee, Highlands, and Hardee Counties contrasted with the positive increase in Charlotte County.

7. G-1.7, pages 34-35: Explain the high percentage change in Sumter County in Figures 6 and 7.

8. G-1.7, Figure 8, page 36: Explain the difference in loss costs changes between Palm Beach and Broward Counties.

Verified: YES

Professional Team Comments:

Reviewed the coordination across personnel working in different standards sections.

Discussed where by-passing hurricanes and hurricane tracks fit are considered in the Figure 2 flowchart.

Reviewed the extent of the Financial Module updates.

Reviewed the model changes from the current accepted model as outlined in G-1.7.

Discussed the error which incorrectly stated percentage differences in loss costs depicted in Figures 5 -8.

Discussed the reasons for the change in loss costs in Sumter County as shown in revised Figures 6 and 7.

Reviewed an example of the process to assure continual agreement among databases, data files, and code.

Additional Verification Review Comments

Additional Verification Review Pre-Visit Letter Questions Related to the Reported Discrepancies

201. Explain in detail the reported discrepancies. Provide the dates that each of the discrepancies were discovered, how the discrepancies were discovered, where the discrepancies were discovered, the underlying cause of the problems, the adjustments to the model to correct the discrepancies, and the process going forward to eliminate the problems in the future.

202. Identify and explain the track changes of the 2023-09-06 version that relate to correcting the discrepancies.

203. Unpack the explanation in the cover letter starting with the sentence: *"The nature of the difference is based on the implementation of financial module updates in the software which included necessary changes for performance and for consistency with the research as presented to the professional team during our on-site review in March, 2023."* Explain the explicit nature and implementation of financial module updates in the software. Explain the specific research previously presented and how the model was inconsistent with this research. Identify the location of changes in the 2023-09-06 submission document relating to this sentence.

204. Elaborate on the cover letter sentence: *"These were found during regular testing procedures for release of Verisk models and platforms."* Describe the regular tests/procedures that led to the discovery of errors. Explain why these "regular" testing procedures did not reveal the discrepancies prior to the October 25, 2022, submission.

205. Describe the extent that these discoveries of discrepancies impact the current accepted model. Explain how the *release process* itself resolves these discrepancies.

206. Describe the extent to which the discrepancies are related to the implementation of the research in each of the four Wojcik et al. papers listed in the Actuarial References.

207. Forms G-1 through G-7 require updated reviews of Touchstone 2023A by the signatories.

Additional Verification Review Pre-Visit Letter Questions

208. G-1.7.A, page 3: Explain why there are no changes in the paragraph on Financial Module Updates.

209. G-1.7.A, page 31: Explain the removal of the roof age assignment change in the revised submission.

210. G-1.7.B-D, pages 32-44: Explain the changes under B. and in the maps under C. and D. Explain the differences in the maximum values given in the maps. Explain why the overall percentage change value remained the same.

Verified: YES

Professional Team Comments:

Reviewed the timeline for identification of the discrepancies in Touchstone 2022A and the revisions in Touchstone 2023A.

Reviewed the changes in loss costs after revised implementation of the financial module in Touchstone 2023A.

Discussed the drivers for the loss cost differences between Touchstone 2022A and Touchstone 2023A.

Discussed other software changes that also led to differences in loss costs.

Reviewed comparisons of the financial component and the total model changes maps of loss cost changes from the current accepted model for Touchstone 2022A and the revised Touchstone 2023A.

Discussed the code review that led to the discovery of errors and the weak points in the process as well as Verisk's ongoing efforts to resolve those weak points.

Confirmed that there are no impacts to the current accepted model.

Confirmed that all Touchstone platforms currently released to model users with the updated financial components under review do not contain the U.S. Hurricane Model V2.0 and cannot be used for a Florida rate filing.

Discussed that the revisions implemented in Touchstone 2023A resolved the differences in the research of the four Wojcik et al. papers and implementation in the software platform.

Discussed that the updates to the Financial Module stated in the original October 25, 2022, submission document are correct and did not require revision. It was implementation of the stated updates that led to the discrepancies being reviewed.

Discussed that the statewide percentage changes in G-1.7.B were made prior to the initial March 2023 on-site review and did not change after revisions were made in Touchstone 2023A. G-1.7.C and G-1.7.D were updated in the September 6, 2023, submission using the revised Touchstone 2023A.

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, Table 2, pages 41-64: Provide resumes of the new personnel.

10. G-2.2C, page 65: Provide complete documentation of the process in Figure 10.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel and consultants:

- C Arunkumar, MBA in Finance and Marketing, Gitam Institute of Management, Visakhapatnam, India; B.E. in Computer Science and Engineering, Sri Venkateshwara College of Engineering, Bengaluru, India

- Julia Borman, Ph.D. in Economics, North Carolina State University, Raleigh, NC; M.Economics, North Carolina State University, Raleigh, NC; B.A. in Mathematics and Economics, St. Mary's College of Maryland, St. Mary's City, MD

- Robert Cabeca, Information Technology Management, University of Phoenix, Phoenix, AZ

- Muralidhar Chittapragada, B.C. in Communications, Osmania University, Hyderabad, India

- Angshuman Deb, Ph.D. in Structural Engineering, University of California, San Diego, CA; M.S. in Structural Engineering, University of California, Sand Diego, CA; B.Tech. in Civil Engineering, National Institute of Technology, Silchar, India

- Ambika Devi, M.S. in Business Economics, Guru Nanak Dev University, Amritsar, India; B.A. in Geography, Delhi University, New Delhi, India

- Anamitra Dhar, B.E. in Electrical Engineering, Calcutta Institute of Engineering and Management, Kolkata, India

- Thomas Diamond, B.A. in Illustration & Design, Massachusetts College of Art, Boston, MA

- Lynn Duffy, M.B.A. in Computer & Information Systems, University of Rochester, Rochester, NY; B.A. in History and English, University of Rochester, Rochester, NY

- Andreea Gavrilescu, B.M. in Statistics, University of Waterloo, Ontario, Canada

- Isabelle Grenier, Ph.D. in Statistical Science, University of California, Santa Cruz, CA; M.S. in Mathematics and Statistics, McGill University, Montreal, Quebec, Canada; B.M. in Statistics, University of Waterloo, Ontario, Canada; B. of Business Administration in Finance, Wilfrid Laurier University, Waterloo, Ontario, Canada

- Tyler Harrington, Ph.D. candidate in Earth System Science, University of Massachusetts, Lowell, MA; M.S. in Environmental Studies, Atmospheric Science, University of Massachusetts, Lowell, MA; M.S. in Finance, University of Texas, Odessa, TX; B.S. in Atmospheric Science and B.A. in Mathematics, University of Kansas, Lawrence, KS

- Utpal Jhurmarwala, M.S. in Information Systems, Northeastern University, Boston, MA; B.S. in Business, Gujarat University, Ahmedabad, India

- Inna Kalita, B.S. in Computer Science, Johnson & Wales University, Providence, RI; B.S. in Education Administration, State Pedagogical Institute, Kiev, Ukraine

- Emma Kaplan, M.S. in Statistics, University of Massachusetts, Amherst, MA; B.A. in Mathematics and Environmental Studies, St. Lawrence University, Canton, NY

- Mohammad Muzzaffar Khan, Ph.D. in Civil Engineering, National Institute of Technology, Warangal, Hanamkonda, India; M.E. in Civil Engineering, University College of Engineering, Osmania University, Hyderabad, India; B.Tech. in Civil Engineering, Jawaharlal Nehru Technology University Hyderabad College of Engineering, Hyderabad, India

- Vladimir Kireyev, M.S. in Mechanical Engineering, Bauman Moscow State Technical University, Moscow, Russia; Information Technology Management, Harvard University, Boston, MA

- Anand Kota, B.S. in Computer Science and Engineering, Gokula Krishna College of Engineering, Krishnareddi Thagelu, India

- Jianjun Luo, Ph.D. in Wind Science and Engineering, Texas Tech University, Lubbock, TX; M.S. in Electronic and Information Engineering, Xi'an Jiaotong University, Xi'an, China; B.S. in Applied Physics, Northwestern Polytechnical University, Xi'an, China

- Eva Marchion, M.A. candidate in User-Centered Design, Brandeis University, Waltham, MA; B.S. in Graphic Design, Northeastern University, Boston, MA

- Andrew O'Donnell, Ph.D. in Civil Engineering, University of Notre Dame, South Bend, IN; M.S. in Civil Engineer, University of Notre Dame, South Bend, IN; B.S. in Civil Engineering, University of Notre Dame, South Bend, IN

- Nithya Palaniappan, M.S. in Computer Applications, Bharathidasan University, India; B.S. in Computer Science, Bharathiar University, Coimbatore, India

- Thomas Renault, M.S. in Mathematics, University of Rouen, Mont-Saint-Aignan, France; B.S. in Mathematics, University of Rouen, Mont-Saint-Aignan, France

- Peter Sousounis, Ph.D. in Meteorology, Pennsylvania State University, College Park, PA; M.S. in Meteorology, Massachusetts Institute of Technology, Cambridge, MA; B.S. in Physics, Drexel University, Philadelphia, PA

- Steve Straight, M.A. in Technical and Professional Writing, Northeastern University, Boston, MA; B.S. in Communications/Media, Fitchburg State University, Fitchburg, MA

- Jennifer Thibeau, M.S. in Geology, University of South Carolina, Columbia, SC; B.A. in Geology, Colgate University, Hamilton, NY

- Niranjan Thirukkovalur, M.S. in Chemical Engineering, Indian Institute of Technology, Kanpur, India; B.S. in Chemical Engineering, Osmania University, Hyderabad, India

- Rafal Wojcik, Ph.D. in Environmental Science, Warsaw Agricultural University, Warsaw, Poland; M.S. in Environmental Engineering, Warsaw Agricultural University, Warsaw University of Technology, Warsaw, Poland

- Pengcheng Wu, M.S. in Data Analytics Engineering, Northeastern University, Boston, MA; B.S. in Energy and Power Engineering, Beijing Institute of Technology, Beijing, China

- Yili Yao, M.S. in Computer Science, Stony Brook University, Stony Brook, NY; B.A. in Computer Science, Clark University, Worcester, MA

- Ivelin Zvezdov, M.S. in Applied Mathematics, University of Houston, Houston, TX; M.Phil. in European Studies, University of Oxford, Oxford, UK; B.A. and M.A. in Economics and International Relations, University of St. Andrews, St. Andrews, Scotland

Reviewed the process for training new employees.

Reviewed the documentation of Verisk workflow as given in Figure 10.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Question

211. G-2-2.B, Table 2, page 56: Provide resumes of new personnel.

Verified: YES

Professional Team Comments:

Reviewed the changes in personnel and the corrections to reported tenures, individual roles, and bios as given in revised Table 2.

Reviewed the resumes of new personnel:

- Connor King, M.S. in Information Systems, University of Maine, Orono, ME; MBA in Analytics and Finance, University of Maine, Orono, ME; B.S. in Wildlife Ecology, University of Maine, Orono, ME

- Christopher Reilly, B.S. in Biostatistics, Emmanuel College, Boston, MA

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 geographic comparisons of the largest 10 ZIP Code centroid movements.

Reviewed geographic displays of ZIP Code boundaries and centroids throughout the state.

Discussed the process for updating ZIP Codes and verification of centroids.

Discussed the treatment of ZIP Code centroids in uninhabitable terrain and over water.

Discussed the geocoding process. Reviewed examples of geocoding incomplete or incorrect street addresses.

Discussed the process for assigning a latitude-longitude to a ZIP Code. Reviewed examples of latitude-longitude ZIP Code conversion.

Discussed that there was no change in methodology for updating ZIP Code-based databases.

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.

*****Additional Verification Review Comments*****

After review of the revisions in Touchstone 2023A, no compensation for potential bias was detected.

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.

Verified: YES

Professional Team Comments:

Reviewed the process for achieving editorial compliance.

Discussed the modification history to the initial submission document on October 25, 2022.

Interviewed the new technical editor Steve Straight.

Editorial items noted in the pre-visit letter and during the review by the Professional Team were satisfactorily addressed. The Professional Team has reviewed the submission per Audit item 3, but cannot guarantee that there are no remaining editorial issues. The modeler is responsible for eliminating editorial errors.

*****Additional Verification Review Comments*****

Reviewed the editorial revisions to the submission document included in the editorial changes list document.

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:

Discussed that the Base Hurricane Storm Set is based on HURDAT2 as of June 10, 2021.

Discussed that the model does not incorporate any modifications to the historical data.

Discussed that the stochastic catalog and windfield model are not partitioned or weighted with respect to time, i.e., no explicit accounting for climate change.

Discussed the rationale for not accounting for climate change.

Reviewed the annual occurrence rates of Florida landfalling hurricanes in Form M-1 compared to Form S-1 and Form A-2. Reviewed the code used for consistency checks among the forms.

Discussed the process for incorporating changes in HURDAT2 for the sake of updating the historical landfall frequency.

Reviewed the storms that were modified and added to the dataset.

Reviewed landfall frequency goodness-of-fit Chi-squared tests by region for Florida and for neighboring states.

Discussed model elements that led to the changes in statewide loss costs due to HURDAT2 updates.

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:

Discussed smoothing of landfall rates by coastal segments.

Reviewed comparisons of historical to modeled annual landfall occurrence rates by category and coastal segments.

Discussed the change in fits for central pressure.

Reviewed comparison of modeled and historical Peak Weighting Factor.

Reviewed how uncertainty in the Gradient Wind Reduction Factor is modeled.

Discussed the far-field pressure values and historical data used to model them.

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.

Pre-Visit Letter

11. M-3.A, page 85: Provide the forward speeds of landfalling hurricanes for 2019 and 2020 to assess the change in averages from the current accepted model.

Verified: YES

Professional Team Comments:

Discussed that no changes have been made to the modeled distributions of parameters in the Base Hurricane Storm Set.

Discussed their definition of "partial landfalling track."

Reviewed comparison of Hurricane Sally (2020) forward speed to the stochastic catalog average forward speed.

Reviewed the methodology for creating stochastic storm tracks. Discussed the dependency on the time of year and modeling of the landfalling calendar date.

Discussed modeling of storms that make multiple landfalls.

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 that the model uses the 2016 National Land Cover Database. Reviewed surface roughness map.

Discussed the year range of storms used for validation of the windfield.

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

Reviewed comparisons of modeled windfields among Hurricane Charley (2004), Hurricane Wilma (2005), Hurricane Irma (2017), and Hurricane Michael (2018).

Discussed the process for converting central pressure deficit to surface winds.

Discussed that treatment of tangential winds and rotational winds are the same, and that these winds are modeled as being above the boundary layer.

Discussed the timing in the model workflow for the application of the asymmetry associated with forward speed.

Discussed the model wind dependence on wind at prior model timestep (one hour).

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 graphical representation of the modeled decay rates for Florida hurricanes compared to central pressure observations.

Discussed that central pressure is the model intensity input.

Discussed the parameters used in the pressure deficit decay function.

Reviewed landfall windfield maps and roughness length maps for Hurricane Andrew (1992), Hurricane Jeanne (2004), and Hurricane Irma (2017).

Discussed how the model handles re-intensification over water and pressure filling for multiple landfall storm events.

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

12. M-6.4, page 99: Explain the changes in Table 3 from the same table as given in the current accepted model. Explain why some of the Min (11.51, 21.58), Max (247.42, 94.94), and Median (51.79) values are the same across different Cp values.
13. Form M-3, page 247: Explain the change in outer radii >40mph values from the current accepted model.

Verified: YES

Professional Team Comments:

Discussed the process for modeling surface roughness length and the effect of surface roughness on windspeed.

Discussed the changes in Table 3 compared to the current accepted model.

Reviewed 100-year and 250-year return period windspeed maps.

Reviewed the relationship between landfalling Rmax and central pressure.

Reviewed the windfield asymmetry calculation. Discussed that there was no change in the methodology from the current accepted model.

Reviewed a correlation matrix used as verification for the logical relationship among stochastic parameters.

Reviewed contour animation of a historical windfield.

Discussed the issue of possible non-stationarity in forward speed in the historical record.

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 enhanced fitting and goodness of fit procedures for annual occurrence frequency, landfall location, central pressure, radius of maximum winds, forward speed, gradient wind reduction factor, heading, landfalling calendar date, and peak weighting factor. Reviewed corresponding goodness-of-fit tests results for each.

Reviewed revised parameter fits for central pressure.

Reviewed validation tests for Hurricane Michael (2018).

*****Additional Verification Review Comments*****

Reviewed revised Forms S-1 and S-2 with updated modeled loss results after revised implementation of the financial module in Touchstone 2023A.

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:

Discussed that the contribution attributable to the sampling process is negligible for the 50,000-year 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

14. S-5.1, pages 118-122: Provide Tables 4 – 9 with actual values rather than scaled values along with scatter plots of these unscaled values.

Verified: YES

Professional Team Comments:

Reviewed scatter plot of actual versus modeled losses with undisguised insurer data for Florida hurricanes.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

212. S-5.1, pages 127-131: Explain the changes in Tables 4-9.

Verified: YES

Professional Team Comments:

Reviewed the updated modeled loss results in the validation comparisons provided in Tables 4 – 9 that were revised after revised implementation of the financial module in Touchstone 2023A. Discussed the percentage change in losses for each Table from Touchstone 2022A in revised Touchstone 2023A.

Reviewed revised scatter plots for the updated comparisons in Form S-4.

Reviewed new scatter plot of actual commercial residential exposures and loss to modeled exposure and loss.

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 the comparison of historical and modeled average annual losses.

Reviewed maps of the percentage of modeled loss cost by county attributable to by-passing stochastic hurricanes and hurricanes with multiple Florida landfalls.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

213. Justify the changes in Forms S-2, S-4, and S-5 with respect to the resolution of the discrepancies.

Verified: YES

Professional Team Comments:

Reviewed the updated historical annual average loss costs from $3.376 billion to $3.328 billion in Form S-5 after revised implementation of the financial module in Touchstone 2023A.

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

15. V-1.G, page 128: Explain how the vulnerability functions implicitly account for damage resulting from water infiltration and missile impact.

16. V-1.1, page 128: Provide a detailed explanation of the items listed under V-1.1.

17. V-1.2, Figure 31, page 129: Explain in detail data and information obtained from damage surveys, including the events surveyed.

18. V-1.6, page 132: Describe how uncertainties associated with building vulnerability functions are derived for wood frame and manufactured home constructions.

19. V-1.7, pages 132-133: Provide the basis for the statement that most residential dwellings are generally classified as non-engineered and whether this is applied statewide. Explain how Building Department requirements that vary from county to county are considered.

20. V-1.7, page 133: Provide the basis for the statement that wind damage is limited to roof covering and cladding at windspeeds less than about 90mph.

21. V-1.11, pages 136-137: Explain in detail weighted averaging of the vulnerability curves where the construction, occupancy, and year of construction are unknown.

22. Form V-1, page 266: For the 161-170mph windspeed band, explain the Contents and Time Element disparities from the Building Damage percentages.

23. Form V-1, page 267: Explain the Time Element loss ratio compared to the Building loss ratio for Manufactured Home.

Verified: YES

Professional Team Comments:

Discussed that no new claims data were added to the current submission.

Discussed that vulnerability functions implicitly account for missile impacts and water infiltration.

Discussed the unknown year-built adjustment and roof year-built assignment updates to be relevant through 2022.

Discussed how the vulnerability functions account for roof aging.

Reviewed code for the roof year-built update that defaults the roof age to a new roof for structures that have been built within the last 10 years.

Discussed the decision process used on whether to modify vulnerability functions based on data from damage surveys. Discussed the U.S. hurricane events that have been surveyed since 2000. Discussed the survey objectives.

Discussed the treatment of uncertainties associated with wood frame and manufactured home constructions.

Reviewed the unknown construction weighting of the vulnerability functions for different construction types.

Reviewed scatter plot of actual to modeled building damage ratios by windspeed.

Discussed with Dr. Carol Friedland, independent external reviewer, her review of the vulnerability module, updates to the vulnerability component, and the vulnerability portion of the submission document.

Reviewed the damage function spreadsheet and an example vulnerability curve. Reviewed implementation of damage functions in the model.

Reviewed scatter plot of modeled to claims damage ratios.

Reviewed the process for capturing spatial and temporal variation in vulnerability due to the evolution of building codes as well as their adoption and enforcement.

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

Reviewed the model building assumptions for construction compliant with the 2010 Florida Building Code.

Discussed the modeler’s plan for implementation of the latest Florida Building Code.

Reviewed comparison of actual losses within the modeled wind footprint for historical events.

Discussed the process for analyzing claims data used for validation.

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

24. V-2.4, page 140: 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 scatter plots of actual and modeled content damage ratios versus windspeed for single-family masonry homes.

Discussed the treatment of uncertainties associated with contents vulnerability functions.

Reviewed Form V-1. Reviewed scatter plot of actual and modeled contents loss.

Reviewed comparison of contents vulnerability functions between 1980 and 2020 construction eras.

Discussed that there were no changes to the contents vulnerability functions from the current acceptable model.

Reviewed the dependence of content damage on the construction type.

Reviewed that contents damage ratios are functions of building damage ratios.

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:

Reviewed the relationship of time-element mean damage ratio to building damage ratio.

Discussed the treatment of uncertainties associated with time-element vulnerability functions.

Reviewed Form V-1. Reviewed scatter plot of actual and modeled time-element loss.

Discussed the time-element loss ratio compared to the building loss ratio for manufacture homes.

Reviewed that there were no changes to the methodology for calculating time-element losses from the current accepted model.

Reviewed time-element vulnerability relationships based on engineering estimates of time to repair for different building damage levels and validated with historical storms claims data.

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.

Pre-Visit Letter

25. Form V-2, page 272: Explain the negative values for Sliding Glass Doors mitigation while meeting windborne debris requirements.

26. Form V-4, page 275: Explain the differences from Form V-2 relative to the current accepted model.

Verified: YES

Professional Team Comments:

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

Reviewed the roof year built secondary risk feature update, which defaults the roof age to a new roof for structures that have been built within the last ten years.

Reviewed the impact of combining secondary structural modification factors.

Reviewed the adjustment to roof age bands.

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

27. A-1.B, page 152: Provide a copy of the Touchstone® Exposure Data Validation Reference.

28. Appendix 6, page 351: Explain why this section of the output log report notes a range from 100 to 1900 rather than 100 to 2000 everywhere else in the report.

29. A-1.9, page 159: Explain how spatial correlation has been incorporated in the analysis.

Verified: YES

Professional Team Comments:

Reviewed an example model input form.

Reviewed the interface and option restrictions for use in Florida rate filings.

Reviewed Touchstone® Exposure Data Validation reference.

Discussed the users and purpose of the output analysis log.

Reviewed the methodology for including spatial correlation in the loss accumulation process.

Discussed that Touchstone's Help documentation describes the data format used to transfer detailed exposure information to the Touchstone software.

*****Additional Verification Review Comments*****

Reviewed the updated import log for Touchstone 2023A.

Reviewed the updated Touchstone 2023A output analysis log.

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

30. A-2.B, page 160: Provide a copy of the documented procedure for distinguishing wind-related hurricane losses from other peril losses.

Verified: YES

Professional Team Comments:

Reviewed the process for distinguishing wind-related losses from other peril losses.

Reviewed the analysis options in the Florida rate filing template.

Reviewed an analysis log using the Florida rate filing template and an analysis log not using the Florida rate filing template.

Discussed that there was no change in the definition of an event in the model.

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

31. A-3.1-4, pages 162-163: 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).

32. A-3.5, pages 163-164: Explain how law and ordinance coverage is implicitly accounted for and handled in the model. Explain how the model handles the statutory 25% and 50% coverages.

Verified: YES

Professional Team Comments:

Reviewed a calculation of loss costs and probable maximum loss levels in Form A-1 for ZIP Code 32046 in Nassau County.

Discussed that the vulnerability functions implicitly account for the statutory 25% or 50% law and ordinance coverage levels.

Discussed the coverage correlation in the updated financial module.

Reviewed the ground-up and gross loss integration from coverage to location loss distribution.

Reviewed an example of the weight optimization procedure.

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

33. A-4.1, page 166: 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.

34. A-4.4, page 168: Provide a copy of the demand surge white paper.

35. A-4, Audit items 1 and 5: Explain how economic inflation with regards to 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.

Reviewed the AIR Demand Surge Function white paper. Discussed that there was no change in methodology from the current accepted model.

Discussed the decay function for aggregation of U.S. demand surge.

Discussed that economic inflation and the effects of the legal environment and litigation effects are not considered in the model.

Reviewed the methodology for determining probable maximum loss levels.

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:

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

Discussed that there was no change in the methodology for estimation of deductibles and policy limits.

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

36. A-6.10, page 176: Provide the details of the calculation of the uncertainty levels.

37. Form A-2, pages 283-284: Explain the differences in losses for Hurricanes NoName09-1947, Isbell-1964, Betsy-1965, Katrina-2005, and Rita-2005 compared to the current accepted model.

38. Form A-4, 0% Deductible, pages 292-296: Explain the reversal in loss costs where Frame is less than Masonry:
    Owners: Gulf Average, Pasco Average, St. Johns Average
    Renters: Dixie Low, Gulf Low, Liberty Low
    Condo Unit: Okaloosa Low, Pasco Average, Wakulla Average.

39. Form A-4, page 293: Explain why the Manufactured Homes Glades County Low value declined while all surrounding counties had their values increase from the current accepted model.

40. Form A-4, page 293: Explain the Frame Renters Average value relative to the Frame Owners Average value for Gulf County.

41. Form A-5, Table 45, page 303: Explain the consistent decreases in Manufactured Homes, Frame Renters, and Masonry Renters from the current accepted model. Identify the model updates that are responsible for these declines.

42. Form A-5, pages 303-312: Explain the regional changes (e.g., Panhandle and Southwest versus North Florida) in the loss costs in Form A-4 compared to the current accepted model.

43. Form A-8, Figure 81, page 329: Explain the increase in losses for higher return periods compared to the current accepted model.

Verified: YES

Professional Team Comments:

Reviewed the process for estimation of uncertainty levels.

Discussed the differences in Form A-2 losses from the current accepted model for hurricanes NoName09-1947, Isbell-1964, Betsy-1965, Katrina-2005, and Rita-2005.

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 decline in Form A-4 loss costs for Manufactured Homes, Glades County Low while surrounding counties had increases from the current accepted model.

Discussed the Form A-4 loss costs for Frame Renters Average relative to Frame Owners Average for Gulf County.

Discussed the model updates that resulted in the Form A-5 percentage decreases from the current accepted model in Manufactured Homes, Frame Renters, and Masonry Renters.

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

Discussed the primary drivers for the increase in losses for higher return periods in Form A-8 compared to the current accepted model.

Discussed that the model produces a total loss distribution, which can be separated into frequency and severity distributions.

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

Additional Verification Review Comments

Additional Verification Review Pre-Visit Letter Questions

214. Justify the adjustments or non-adjustments to the Actuarial forms with respect to changes in the model for the 2023-09-06 submission.

215. Form A-2, pages 300-303: Explain why the direction and magnitude of the changes are storm dependent. In particular, explain the changes in modeled losses for Lake Okeechobe-1928, NoName07-1935, NoName09-1945, NoName04-1947, King-1950, and Wilma-2005.

216. Form A-3: Explain the differences for ZIP Codes 32209 and 33158 for Hurricane Irma (2017). Provide a revised Form A-3 in accordance with the Report of Activities when submitting the additional verification review materials due on October 30, 2023. Explain why Form A-3 was omitted from the list of Form changes made for the September 2023 revision.

217. Form A-4: Explain how the discrepancy revision had no impact on 0% deductibles.

218. Form A-4: Explain the differences in the Specified Deductible tables. In particular, explain the differences in the following counties:
    a. Frame Owners – Baker
    b. Masonry Owners – Columbia
    c. Manufactured Homes – Hamilton
    d. Frame Condo Units – Leon
    e. Masonry Condo Units – Alachua
    f. Commercial Residential – Washington.

219. Form A-4: Explain why there are no differences in Frame and Masonry Renters.

220. Form A-4: Explain why counties with lower changes are primarily located along the coast. Explain why this is a result of changes in the resubmission.

221. Form A-4: Explain why the adjustments are all non-negative.

222. Provide Form A-6, along with the other additional verification review materials, on October 30, 2023.

223. Form A-8, pages 354-357: Explain the differences in Part A, Total Hurricane Loss. Explain the differences in Parts B and C uncertainty estimates.

224. Appendix 6, pages 358-413: Explain the changes to the Analysis Log in the model output form. In particular, explain the inclusion or exclusion of the following entries in the revised Analysis Log:
    a. Event Set Options Off/On for Event, Year, Location, Rule Filters
    b. Intra- and Inter-Policy Correlation Factor: 0%
    c. Order of Application of Fac:
    d. Loss Perspectives Ground Up Retained Gross
    e. Requested Min-Max Resources
    f. PreprocessChunk became GenerateChunkTables
    g. ProcessSlice-5 (HIST).

225. Appendix 6, pages 358-413: With respect to the revised Analysis Log output, explain the addition of subprocesses in the PhysPrep Process 1-1473 and PhysPrep Process 1474-2946, and the revised approach to physical properties files.

Verified: YES

Professional Team Comments:

Reviewed the following revised forms after revised implementation of the financial module in Touchstone 2023A.

- Form A-1
- Form A-2
- Form A-3
- Form A-4 updated specified deductible output ranges
- Form A-5 updated percentage change in specified deductible output ranges and maps updated with the Touchstone 2023A loss results
- Form A-6 updated deductible sensitivity test
- Form A-7
- Form A-8

Reviewed graphical comparison of an example distribution of damage ratios around the mean between Touchstone 2022A and Touchstone 2023A.

Discussed why the revisions in Touchstone 2023A had no measurable impact on 0% deductibles in Form A-4.

Reviewed the Form A-4 differences for Specified Deductibles for Frame Owners in Baker County, Masonry Owners in Columbia County, Manufactured Homes in Hamilton County, Frame Condo Units in Leon County, Masonry Condo Units in Alachua County, and Commercial Residential in Washington County.

Reviewed why there are no differences in Form A-4, Frame and Masonry Renters, between Touchstone 2022A and the revised Touchstone 2023A.

Discussed why counties with lower percentage changes were primarily located along the coast. Reviewed graph of the cumulative percent of locations with estimated Coverage A Mean Damage Ratios.

Discussed that loss cost changes in Form A-4, Specified Deductible, were all non-negative in Touchstone 2023A.

Reviewed graphical comparisons of the loss cost ratios in the Form A-6 deductible sensitivity set between Touchstone 2022A and revised Touchstone 2023A. Discussed the change in loss costs with changes in deductibles.

Reviewed the changes to the Analysis Log in the model output form which resulted from process changes made in Touchstone 2023A.

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

44. CI-1.B, pages 178-179: Relate the primary binder table of contents with the response to Standard G-1.7 (pages 30-37) by demonstrating individual table item compliance with Computer/Information Standards CI-1 through CI-8.

45. CI-1.D, page 179: Provide the table required by CI-1, Audit item 7.

46. CI-1.F, page 179: Provide the *List of All Externally-Acquired Hurricane Model-Specific Software and Data Assets* spreadsheet as described and required by Standard CI-1, Audit item 6.

Verified: YES

Professional Team Comments:

Reviewed the Touchstone Exposure Data Validation Reference for residential construction and occupancy class codes.

Reviewed Model 521 Catastrophe Model Implementation documentation.

Reviewed the enhancement map of model changes.

Reviewed Model 521 Hurricane Model for the United States Scope Document.

Reviewed the list of externally acquired currently used hurricane model-specific software and data assets.

Discussed that the justifications for vintage of code and data will be presented to the Commission during the trade secret closed session.

Discussed with Robert Cabeca, independent external reviewer, his review of the model and compliance with the Computer Information Standards.

Discussed Mr. Cabeca's recommendation to Verisk on exploring and implementing enhanced document naming conventions. Discussed the actions undertaken for improvement of document naming conventions.

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

Reviewed the Next Generation Modeling Loss Accumulation algorithms documentation.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

226. An interview with Robert Cabeca on November 2, 2023, is requested.

227. CI-1.B, pages 188-189: Relate the primary binder table of contents with the response to Standard G-1.7 (pages 30-32) by demonstrating individual table item compliance with Computer/Information Standards CI-1 through CI-8.

228. CI-1.D, page 189: Provide the table required by CI-1, Audit item 7.

229. CI-1.F, page 189: Provide the *List of All Externally-Acquired Hurricane Model-Specific Software and Data Assets* spreadsheet as described and required by Standard CI-1, Audit item 6.

Verified: YES

Professional Team Comments:

Discussed Robert Cabeca's review of Touchstone 2023A after revised implementation of the financial module.

Reviewed the enhancements map documentation that maps the hurricane model changes specified in G-1.7 through all the Computer/Information Standards.

Reviewed the accumulation of distributions with correlation documentation updated October, 2023.

Reviewed the list of externally acquired currently used hurricane model-specific software and data assets.

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

47. CI-2, pages 180-182: Provide requirements documentation that specifically relates to each model change identified in Standard G-1.7 (pages 30-31).

Verified: YES

Professional Team Comments:

Reviewed flowchart for generating the Model Scope and Requirements.

Reviewed software requirements documentation in the enhancement map of model changes.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

230. CI-2, pages 190-192: Provide requirements documentation that specifically relates to each model change identified in Standard G-1.7 (pages 30-32).

Verified: YES

Professional Team Comments:

Reviewed software requirements documentation in the enhancement map of model changes.

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.

Pre-Visit Letter

48. CI-3.B, page 195: Provide the Verisk Flowchart Mapping Standards document.

Verified: YES

Professional Team Comments:

Reviewed the Verisk Flowchart Standards.

Reviewed flowchart for processing changes in HURDAT2 in calculating landfall distributions.

Discussed that the model is implemented on a single platform.

Reviewed the financial engine flowchart.

Reviewed flowchart for the financial module workflow.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

231. CI-3.B, page 206: Provide the Verisk Flowchart Mapping Standards document.

Verified: YES

Professional Team Comments:

Reviewed the Verisk Flowchart Standards. Discussed that they are unchanged from the March 2023 on-site review.

Reviewed the Touchstone Testing Process flowchart and discussed sub-level testing not detailed in the flowchart.

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

49. Appendix 7, page 382: Explain details of the training processes.

Verified: YES

Professional Team Comments:

Reviewed implementation of the roof year-built update to default the roof age to a new roof for structures that have been built within the last 10 years.

Reviewed implementation of damage functions.

Reviewed implementation of duration for accumulating damage.

Reviewed the coding guidelines.

Reviewed the coding training process.

Reviewed procedures for generating Touchstone databases and generating data files.

Reviewed the spreadsheet with code line counts for the updated financial module.

Reviewed the Touchstone network organization.

Reviewed implementation of the split-atom convolution in the updated financial module.

Reviewed implementation of the Rmax regression model.

Reviewed the variable mapping for the financial module equations.

Reviewed the variable mapping for the Rmax regression model equations.

Discussed that the modeler will continue updating documentation relative to mathematical expressions and variable mapping for equations and corresponding code.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

232. Appendix 7, page 432: Explain details of the training processes.

Verified: YES

Professional Team Comments:

Reviewed the software training process. Discussed the plan to review and update the "Coding Standards Training" to increase emphasis on code review and logical checks.

Discussed that significant improvements are being made to the automated form scripts. Reviewed the updated script for producing Form A-4.

Reviewed the code changes and subsequent updates to the financial module equations, formulas and variable mapping documentation.

Reviewed code for different algorithmic processing in the financial module that can lead to changes in losses.

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

50. CI-5, pages 210-215: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1.7 (pages 30-31).

51. Appendix 7, page 384: Explain the sprint cycle in software testing.

Verified: YES

Professional Team Comments:

Reviewed code for consistency checks among Forms M-1, S-1, and A-2.

Reviewed regression testing on unchanged event losses for various construction and occupancy types.

Reviewed Quality Assurance test plans for Touchstone 2022A. Reviewed the Summary of Quality Assurance Process for Touchstone 2022A.

Reviewed documentation on data testing and example QA Test Plans.

Reviewed the procedure for unit conversion verification.

Discussed the sprint cycle software testing process for certifying each sprint build.

Reviewed the logical assertions, exception handling, and flag triggered outputs documentation.

Discussed the assertions, exception handling, and testing output statements.

Reviewed the testing process flowchart.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

233. CI-5, pages 221-226: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1.7 (pages 30-32).

234. Appendix 7, page 434: Explain the sprint cycle in software testing.

Verified: YES

Professional Team Comments:

Reviewed an example QA test plan and the results to test updated coverage correlation weights.

Reviewed Summary of the QA process. Discussed that there were no changes in the process.

Reviewed the Touchstone testing process flowchart.

Reviewed the process for certifying each sprint build.

Discussed that a process to implement explicit testing is being developed. The new testing process will be designed to catch the implementation errors in Touchstone platforms at an earlier stage.

Discussed plans for future development of checks that can be performed platform to platform.

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

52. CI-6.C, page 217: Provide and explain the *Florida Rate Filing Analysis Template*.

Verified: YES

Professional Team Comments:

Reviewed the Florida Rate Filing Analysis Template with pre-defined values for a Florida rate filing.

Reviewed the system controls for ensuring user selections cannot be changed when using the Florida Rate Filing Analysis Template.

Reviewed the analysis options available to the user. Discussed that the options selected by the user will be included on the model output report.
Reviewed the design and implementation of the user interface.

*****Additional Verification Review Comments*****

Additional Verification Review Pre-Visit Letter Questions

235. CI-6.A, page 227: Describe how the production of the Analysis Log in Appendix 6 is consistent with CI-6.A.

236. CI-6.C, page 228: Provide and explain the *Florida Rate Filing Analysis Template*.

Verified: YES

Professional Team Comments:

Reviewed the Florida Regulatory template that is shown in the analysis log output and identifies the template and associated options employed by the model user. Discussed that the template and associated analysis log output are unchanged between Touchstone 2022A and revised Touchstone 2023A.

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

53. CI-7.D, page 223: 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 change history.

Discussed the use of Team Foundation Version Control (TFVC) and Microsoft Office SharePoint Server for version control.

Additional Verification Review Comments

Additional Verification Review Pre-Visit Letter Questions

237. CI-7.D, page 235: Provide the model version history over the past 5 years, leading up to the version identified in the 2023-09-06 submission.

Verified: YES

Professional Team Comments:

Reviewed the model version change history listing the version changes for each Touchstone and U.S. Hurricane model release.

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 Information Security Policy Framework.

Discussed that there have been no known security breaches.