**Computer/INFORMATION Standards**

**CI-1 Hurricane Model Documentation\***

*(\*Significant Revision)*

1. ***Hurricane model functionality and technical descriptions shall be documented formally in an archival format separate from the use of letters, slides, and unformatted text files.***
2. ***The modeling organization shall maintain a primary document repository, 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.***
3. ***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.***
4. ***The modeling organization shall maintain (1) a table of all changes in the hurricane model from the previously-accepted hurricane model to the initial submission this year and (2) a table of all substantive changes since this year’s initial submission.***
5. ***Documentation shall be created separately from the source code.***
6. ***The modeling organization shall maintain a list of all externally acquired hurricane model-specific assets (e.g., software, data). The list shall include (1) asset name, (2) asset version number, (3) date asset acquired, (4) source from which asset was acquired, (5) mode of asset acquisition (e.g., lease, purchase, open source) and sustainment, and (6) length of time asset has been in use by the modeling organization.***

Suggestion and Questions from RMS:

**Problem Statement:** Standard CI-1.F does not distinguish Florida hurricane models from other models.

**Explanation:** Editorial proposal to distinguish hurricane models from other models (e.g., flood) to align with other areas where careful attention has been made to do so.

**Amendatory Language:**

F. The modeling organization shall maintain a list of all externally acquired Florida hurricane model-specific assets (e.g., software, data).

**Questions:** Further clarification is requested on Standard CI-1.F:

What would qualify as a software asset?

Does the asset refer to what is shipped to clients?

Or does it refer also to the data and software used within RMS for hurricane model development like Microsoft Excel, Microsoft SQL Server, Visual Studio, etc.?

Further clarification is also required on “sustainment;” does this mean how we plan to support fixes and upgrades to the assets or something else?

Purpose:

To capture all aspects of *documenting* the hurricane model. Documentation enables the modeling organization personnel to create a shared, formal organizational structure of all information specifically related to the hurricane model. This structure may include many forms of media such as printed documentation, diagrams, and time-based media such as animations.

 Relevant Form: G-6, Computer/Information Standards Expert Certification

**Audit**

1. The primary document repository, in either electronic or physical form, and its maintenance process will be reviewed. The repository should contain or reference full documentation of the software.
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 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 assets (e.g., software, data) will be reviewed.
7. The tables specified in CI-1.D that contain the items listed in Standard G-1, Scope of the Hurricane Model and Its Implementation, Disclosure 5 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 Standards: CI-2, Hurricane Model Requirements, CI-3, Hurricane Model Architecture and Component Design, CI-4, Hurricane Model Implementation, CI-5, Hurricane Model Verification, and CI-6, Hurricane Model Maintenance and Revision.

8. Tracing of the hurricane model changes specified in Standard G-1, Scope of the Hurricane Model and Its Implementation, Disclosure 5 and Audit 5 through all Computer/Information Standards will be reviewed.

**CI-2 Hurricane Model Requirements**

***The modeling organization shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component. Requirements shall be updated whenever changes are made to the hurricane model.***

Purpose: To define an initial stage of hurricane model development. Software development begins with a thorough *specification of requirements* for each component, database, or data file accessed by a component. These requirements are frequently documented informally in natural language, with the addition of illustrations that aid both users and software engineers in specifying components, databases, or data files accessed by a component for the software product and process. Requirements drive the subsequent design (CI-3, Hurricane Model Architecture and Component Design), implementation (CI-4, Hurricane Model Implementation), and verification (CI-5, Hurricane Model Verification) of the hurricane model.

 A typical division of requirements into categories would include:

1. ***Interface:*** For example,use the web browser Internet Explorer, with ActiveX technology, to show county and ZIP Code maps of Florida. Allow text search commands for browsing and locating counties.

2. ***Human Factors:*** For example, ZIP Code boundaries, and contents, can be scaled to the extent that the average user can visually identify residential home exposures marked with small circles.

3. ***Functionality:*** For example, make the software design at the topmost level a data flowchart containing the following components: HURRICANES, WINDFIELD, DAMAGE, and HURRICANE LOSS COSTS. Write the low-level code in Java.

4. ***Documentation:*** For example, use Acrobat PDF for the layout language, and add PDF hyperlinks in documents to connect the sub-documents.

5. ***Data:*** For example, store the hurricane vulnerability data in an Excel spreadsheet using a different sheet for each construction type.

6. ***Human Resources:*** For example, task individuals for the six-month coding of the windfield simulation. Ask others to design the user-interface by working with the Quality Assurance team.

7. ***System Models***: For example, models with representations of software, data, and associated human collaboration, will use Business Process Model and Notation (BPMN), Unified Modeling Language (UML), or Systems Modeling Language (SysML).

8. ***Security:*** For example, store tapes off-site, with incremental daily backups. Password-protect all source files.

9. ***Quality Assurance:*** For example, filter insurance claims data against norms and extremes created for the last project.

 Relevant Form: G-6, Computer/Information Standards Expert Certification

**Disclosure**

1. Provide a description of the documentation for interface, human factors, functionality, documentation, data, human and material resources, security, and quality assurance.

**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.

**CI-3 Hurricane Model Architecture and Component Design\***

 *(\*Significant Revision)*

1. ***The modeling organization shall maintain and document (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, and (4) system model representations associated with (1)-(3). Documentation shall be to the level of components that make significant contributions to the hurricane model output.***
2. ***All flowcharts (e.g., software, data, and system models) shall be based on (1) a referenced industry standard (e.g., Unified Modeling Language (UML), Business Process Model and Notation (BPMN), Systems Modeling Language (SysML)), or (2) a comparable internally-developed standard which is separately documented.***

Purpose: To *design* the hurricane model once requirements (CI-2, Hurricane Model Requirements) have been specified. The software system (comprised of code and data) and the business process (composed of people and information flows) are designed as a collection of interconnected components. These components are frequently specified in hierarchical flowcharts and diagrams. Example components might include HURRICANES, WINDFIELD, DAMAGE, and HURRICANE LOSS COSTS, and the major sub-components of each. The purpose of each example component is, as follows:

1. HURRICANES accepts historical hurricane sets and generates historical and stochastic storm trajectories;

2. WINDFIELD accepts the output from HURRICANES and produces site-specific winds;

3. DAMAGE accepts the output from WINDFIELD and generates damage to building;

4. HURRICANE LOSS COSTS accepts the output from DAMAGE and generates hurricane loss costs.

 Relevant Form: G-6, Computer/Information Standards Expert Certification

**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, and

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).

1. A hurricane model component custodian, or designated proxy, should be available for the review of each component.
2. The flowchart reference guide or industry standard reference will be reviewed.

**CI-4 Hurricane Model Implementation**

***A. The modeling organization shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.***

***B. The modeling organization shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.***

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

***D. The modeling organization shall maintain a table of all software components affecting hurricane loss costs and hurricane probable maximum loss levels, 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.***

***E. 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.***

***F. The modeling organization shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Scope of the Hurricane Model and Its Implementation, Disclosure 5 and Audit 5:***

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

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

 Purpose:

To *implement* the hurricane model based on requirements (CI-2, Hurricane Model Requirements) and design (CI-3, Hurricane Model Architecture and Component Design). The hurricane model implementation is created using computer software (i.e., code) and data. Elements formed in the design stage should be fully traceable to components of the implementation. The design stage serves as an abstract, and often visual, representation of the underlying implementation comprised of code and data.

 Relevant Form: G-6, Computer/Information Standards Expert Certification

**Disclosure**

1. Specify the hardware, operating system, other software, and all computer languages required to use the hurricane model.

**Audit**

1. The interfaces and the coupling assumptions will be reviewed.

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.

1. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.
2. The traceability among components at all levels of representation will be reviewed.
3. The following information will be reviewed for each component, either in a header comment block, source control database, or the documentation:
	1. Component name,
	2. Date created,
	3. Dates modified, modification rationale, and by whom,
	4. Purpose or function of the component, and
	5. Input and output parameter definitions.
4. The table of all software components as specified in CI-4.D will be reviewed.
5. Hurricane model components and the method of mapping to elements in the computer program will be reviewed.
6. Comments within components will be reviewed for sufficiency, consistency, and explanatory quality.

**CI-5 Hurricane Model Verification**

1. ***General***

***For each component, the modeling organization shall maintain procedures 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.***

1. ***Component Testing***

***1. The modeling organization shall use testing software to assist in documenting and analyzing all components.***

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

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

***4. Aggregation 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. The modeling organization shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.***

***2. The modeling organization shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.***

Purpose:

To ensure a correct mapping from executing the implementation (CI-4, Hurricane Model Implementation) to previously-specified requirements (CI-2, Hurricane Model Requirements), and design (CI-3, Hurricane Model Architecture and Component Design). *Verification* requires tests to be run by varying component inputs to ensure correct output.

 Relevant Form: G-6, Computer/Information Standards Expert Certification

**Disclosures**

1. State whether any two executions of the hurricane model with no changes in input data, parameters, code, and seeds of random number generators produce the same hurricane loss costs and hurricane probable maximum loss levels.
2. Provide an overview of the component testing procedures.
3. Provide a description of verification approaches used for externally acquired data, software, and models.

**Audit**

1. 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.
2. The testing software used by the modeling organization will be reviewed.
3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.
4. 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.
5. Flowcharts defining the processes used for manual and automatic verification will be reviewed.
6. Verification approaches used for externally acquired data, software, and models will be reviewed.

**CI-6 Hurricane Model Maintenance and Revision**

1. ***The modeling organization shall maintain a clearly written policy for hurricane model review, maintenance, and revision, including verification and validation of revised components, databases, and data files.***
2. ***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.***
3. ***The modeling organization shall use tracking software to identify and describe all errors, as well as modifications to code, data, and documentation.***
4. ***The modeling organization shall maintain a list of all hurricane model versions since the initial submission for this year. Each hurricane model description shall have a unique version identification and a list of additions, deletions, and changes that define that version.***

Purpose:

To create a formal procedure for identifying, organizing and *maintaining* *hurricane model versions*. Hurricane model software, data, and documentation are stored in an online system that tracks all editing changes by author and change date.

 Relevant Form: G-6, Computer/Information Standards Expert Certification

**Disclosures**

1. Identify procedures used to review and maintain code, data, and documentation.

2. Describe the rules underlying the hurricane model and code revision identification systems.

**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.

1. The policy for hurricane model revision and management will be reviewed.
2. 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 CI-6.D will be reviewed.

**CI-7 Hurricane Model Security**

***The modeling organization shall have implemented and fully documented security procedures 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.***

Purpose: To ensure that the hurricane model is *secured* against unauthorized access. Security procedures are necessary to maintain an adequate, secure, and correct base for code, data, and documentation. The modeling organization is expected to have a secure location supporting all code, data, and documentation development and maintenance. Necessary measures include, but are not limited to, (1) virus protection, (2) limited access protocols for software, hardware, and networks, and (3) backup and redundancy procedures.

 Relevant Form: G-6, Computer/Information Standards Expert Certification

**Disclosure**

1. Describe methods used to ensure the security and integrity of the code, data, and documentation.

**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.