

## COMPUTER FLOOD STANDARDS

### CF-1 Flood Model Documentation

- A. Flood model functionality and technical descriptions shall be documented formally in an archival format separate from the use of letters, slides, and unformatted text files.***
- B. The modeling organization shall maintain a primary document repository, containing or referencing a complete set of documentation specifying the flood model structure, detailed software description, and functionality. Development of the documentation shall be indicative of accepted software engineering practices.***
- C. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the submission shall be consistently documented and dated.***
- D. The modeling organization shall maintain a table of all substantive changes in the flood model since this year's initial submission.***
- E. Documentation shall be created separately from the source code.***

Purpose: This standard requires the primary document repository to contain or reference all the elements of the flood model and its development.

In some cases, a user may be offsite, and in others, the users may be modeling organization personnel. In either case, clearly written documentation is necessary to maintain the consistency and survivability of the code, irrespective of specific modeling organization personnel.

Relevant Form: GF-6, Computer Flood Standards Expert Certification

#### **Audit**

1. The primary document repository, in either electronic or physical form, and its maintenance process will be reviewed. The repository shall contain or reference full documentation of the software.
2. All documentation shall be easily accessible from a central location.
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) shall be present when the Computer Flood Standards are being audited. Internal users of the software will be interviewed.
5. Provide verification that documentation is created separately from and is maintained consistently with the source code.
  6. The tables specified in CF-1.D that contain the items listed in Standard GF-1 (Scope of the Computer Flood Model and Its Implementation), Disclosure 5 and Audit 6 will be reviewed. The tables shall contain the item number in the first column. The remaining five columns shall contain specific document or file references for affected components or data relating to the following Computer Standards: CF-2 (Flood Model Requirements), CF-3 (Flood Model Architecture and Component Design), CF-4 (Flood Model Implementation), CF-5 (Flood Model Verification), and CF-6 (Flood Model Maintenance and Revision).
  7. Trace the flood model changes specified in Standard GF-1 (Scope of the Computer Flood Model and Its Implementation), Disclosure 5 and Audit 6 through all Computer Flood Standards.

## CF-2 Flood 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 flood model.***

Purpose: 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 diagrams and other 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 design and implementation of the flood 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 dataflow diagram containing the following components: FLOODS, FLOOD EXTENT AND DEPTH, DAMAGE, and 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 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 flood extent and depth simulation. Ask others to design the user-interface by working with the Quality Assurance team.
7. ***Security:*** For example, store tapes off-site, with incremental daily backups. Password-protect all source files.
8. ***Quality Assurance:*** For example, filter insurance company data against norms and extremes created for the last project.

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**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. Provide confirmation that a complete set of requirements for each software component, as well as for each database or data file accessed by a component, has been maintained and documented.

## CF-3 Flood Model Architecture and Component Design

*The modeling organization shall maintain and document (1) detailed control and data flow diagrams and interface specifications for each software component, (2) schema definitions for each database and data file, and (3) diagrams illustrating flood model-related flow of information and its processing by modeling organization personnel or team. Documentation shall be to the level of components that make significant contributions to the flood model output.*

Purpose: Component-based design is essential in creating software that reduces errors and promotes comprehension of the role for each component. Moreover, the component network needs to be shown to operate “as a whole.” Example components include FLOODS, FLOOD EXTENT AND DEPTH, DAMAGE, and LOSS COSTS, and the major components of each. The purpose of each example component is, as follows:

1. FLOODS accepts historical flood event data sources and generates historical and stochastic flood events;
2. FLOOD EXTENT AND DEPTH accepts the output from FLOODS and produces site-specific water height and force;
3. DAMAGE accepts the output from FLOOD EXTENT AND DEPTH and generates damage to building;
4. LOSS COSTS accepts the output from DAMAGE and generates loss costs.

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### Audit

1. The following will be reviewed:
  - a. Detailed control and data flow diagrams, completely and sufficiently labeled for each component,
  - b. Interface specifications for all components in the flood model,
  - c. Documentation for schemas for all data files, along with field type definitions,
  - d. Each network diagram including components, sub-component diagrams, arcs, and labels, and
  - e. Diagrams illustrating flood model-related information flow among modeling organization personnel or team (e.g., using Unified Modeling Language (UML), Business Process Model and Notation (BPMN), or equivalent technique including a modeling organization internal standard).

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

## CF-4 Flood 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 flow diagrams, down to the code level.*
- D. The modeling organization shall maintain a table of all software components affecting flood loss costs, 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 GF-1 (Scope of the Computer Flood Model and Its Implementation), Disclosure 5 and Audit 6:*
  - 1. A list of all equations and formulas used in documentation of the flood 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.*

Purpose: A high-level graphical view of a program promotes understanding and maintenance. All compositions are to be made clear through explicit textual or interactively supported reference within each graphical component. Each component is refined into subcomponents, and at the end of the component tree there are blocks of code. All documentation and binder identifications are to be referenced within this tree. This creates a traceable design from aggregate components down to the code level.

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**Disclosure**

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

**Audit**

1. The interfaces and the coupling assumptions will be reviewed.
2. Provide the documented coding guidelines and confirm that these guidelines are uniformly implemented.
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 and by whom,
  - d. Purpose or function of the component,
  - e. Input and output parameter definitions.
6. The table of all software components as specified in CF-4.D will be reviewed.
7. Flood model components and the method of mapping to elements in the computer program will be reviewed.
8. Comments within components will be examined for sufficiency, consistency, and explanatory quality.

## CF-5 Flood Model Verification

### A. 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.***

### B. 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 flood 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:** This standard requires tests to be run by varying component inputs to ensure correct output. Invariants are one method of achieving verification, where one brackets a block of code to ensure that data values do not stray from their required ranges. Other methods of verification include hand-calculations or parallel coding efforts (using a different language or tool, but with the same requirements).

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**Disclosures**

1. State whether any two executions of the flood model with no changes in input data, parameters, code, and seeds of random number generators produce the same flood loss costs and flood 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. The response to Disclosure 1 will be reviewed.
7. Verification approaches used for externally acquired data, software, and models will be reviewed.

## CF-6 Flood Model Maintenance and Revision

- A. The modeling organization shall maintain a clearly written policy for flood model revision, including verification and validation of revised components, databases, and data files.***
- B. A revision to any portion of the flood model that results in a change in any Florida personal residential flood loss cost or flood probable maximum loss level shall result in a new flood model version identification.***
- C. The modeling organization shall use tracking software to identify and describe all errors, as well as modifications to code, data, and documentation.***
- D. The modeling organization shall maintain a list of all flood model versions since the initial submission for this year. Each flood model description shall have a unique version identification, and a list of additions, deletions, and changes that define that version.***

Purpose: The Commission will determine to be acceptable only those flood models for which the owners have a clearly written policy for flood model revision with respect to methodologies and data.

Once the software is constructed, it is essential to track and maintain all source code, data, and documentation through a unique version identification system.

Relevant Form: GF-6, Computer Flood Standards Expert Certification

### Disclosures

1. Identify procedures used to maintain code, data, and documentation.
2. Describe the rules underlying the flood model and code revision identification systems.

### Audit

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

3. The tracking software will be reviewed and checked for the ability to track date and time.
4. The list of all flood model revisions as specified in CF-6.D will be reviewed.

## CF-7 Flood 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 flood 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: 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.

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### Disclosure

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

### Audit

1. The written policy for all procedures and methods used to ensure the security of code, data, and documentation will be reviewed. Specify all security procedures.
2. Documented security procedures for access, client flood model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.