



Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

Model Validation

Revision: 0

Effective Date is 3 days after the date of approval

Prepared By: Signature on File 02/12/16
Robert Hasson **Date**
Ash Fall Project QA Lead

Approved By: Signature on File 02/25/16
Kelly Ebert **Date**
ORP Ash Fall Project Engineer

Concurrence: Signature on File 02/25/16
Ken Armstrong **Date**
EMCBC Assistant Director,
Office of Technical Support and Asset Management

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

1.0 PURPOSE

The purpose of this procedure establishes the responsibilities and process to be used for model development and model validation activities for the Ash Fall Project.

2.0 SCOPE

The scope of this procedure is to describe the process for developing a model and for validating a model implemented by the Department of Energy Environmental Management Consolidated Business Center (EMCBC) Ash Fall Project supporting the Office of River Protection (ORP) Program.

3.0 APPLICABILITY

This procedure applies to EMCBC Ash Fall Project personnel supporting the ORP Program who are responsible for model development and validation that are important to Ash Fall Distribution and Resuspension research and development activities.

4.0 REQUIREMENTS and REFERENCES

4.1 Requirements

4.1.1 EM-QA-001, *EM Quality Assurance Program (QAP)*

4.1.2 ASME NQA-1-2008/2009a, *Quality Assurance Requirements for Nuclear Facility Applications*

4.2 References

4.2.1 AFP-QAPP-01, *Quality Assurance Project Plan (QAPP)*

4.2.2 AFP-AP-03, *Data Control*

4.2.3 AFP-AP-04, *Qualification of Unqualified Data*

4.2.4 AFP-AP-05, *Control of the Electronic Management of Information*

4.2.5 AFP-AP-06, *Software Management Control*

4.2.6 AFP-AP-10, *Peer Review*

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

4.2.7 AFP-AP-13, *Document Review*

4.2.8 AFP-AP-14, *Document Control*

4.2.9 AFP-AP-20, *Quality Assurance Records*

4.2.10 AFP-AP-21, *Laboratory Notebook Control*

5.0 DEFINITIONS and ACRONYMS

- 5.1 Abstraction – The process of purposely simplifying a mathematical model (component, barrier, or subsystem process model) for incorporation into an overall system model. The products of model abstractions may represent reduction in dimensionality, elimination of time dependence, tables obtained from more complex models, response surfaces derived from the use of more complex models, representations of a continuous process or entity with a few discrete elements, etc.
- 5.2 Assumption – A statement or proposition that is taken to be true or representative in the absence of direct confirming data or evidence, or those estimations, approximations, and/or limitations made during model development (such as when expanding the range of variables to achieve conservatism).
- 5.3 Editorial Correction – Modifications made to a document such as correcting grammar, spelling, or typographical errors; renumbering sections or attachments; and updating organization titles. Editorial corrections do not affect the chronological sequence of work or the fundamental process, or change responsibilities.
- 5.4 Independent Technical Reviewer – As used in this procedure, a qualified individual other than the Checker and Originator technically competent in the subject area of the document undergoing review responsible for confirming the adequacy, accuracy, and completeness of the model documentation and for performing the validation of the model documentation.
- 5.5 Model – A representation of a system, process, or phenomenon, along with any hypotheses required to describe the process or system or explain the phenomenon, often mathematically. Model development typically progresses from conceptual to mathematical models. Mathematical model development typically progresses from process, to abstraction, and to system models.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

- 5.6 Model, Abstraction – A product of the abstraction process that meets the definition of a mathematical model.
- 5.7 Model, Conceptual – A set of hypotheses consisting of assumptions, simplifications, and idealizations that describes the essential aspects of a system, process, or phenomenon. Such a model may consist of concepts related to geometrical elements of the object (size or shape); dimensionality (one-, two-, or three-dimensional); time dependence (steady-state or transient); applicable conservation principles (mass, momentum, energy); applicable constitutive relations, significant processes, natural laws, and boundary conditions; and initial conditions. Conceptual models may be implemented into mathematical models.
- 5.8 Model, Mathematical – A mathematical representation of a conceptual model (system, process, or phenomenon) that is based on established scientific and engineering principles and from which the approximate behavior of a system, process, or phenomenon can be calculated within determinable limits of uncertainty.
- 5.9 Model, Process – A mathematical model that represents an event, phenomenon, process, component, etc., or series of events, phenomena, processes, or components, etc. A process model may undergo an abstraction for incorporation into a system model.
- 5.10 Model, System – A collection of interrelated mathematical models that represent the overall system.
- 5.11 Model Validation – A process used to establish confidence that a mathematical model and its underlying conceptual model adequately represents with sufficient accuracy the phenomenon, process, or system in question.
- 5.12 Originator – A technically competent individual designated to perform a model activity and to prepare the model documentation and assigned the responsibility for ensuring the adequacy, accuracy, and completeness of the model documentation.
- 5.13 Responsible Manager – The individual having management responsibility for a model activity and for approving the model documentation.
- 5.14 Scientific Analysis – A documented study that 1) defines, calculates, or investigates scientific phenomena or parameters; 2) evaluates performance of components; or 3) solves a mathematical problem by formula, algorithm or other numerical method. A scientific analysis may involve numerical manipulations that are not part of a

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

previously developed and validated mathematical model if the choice of method is evident from standard scientific practice, approach, or method. A scientific analysis may also use a previously developed and validated mathematical model, within the mathematical model's intended use and stated limitations, but may not revise the mathematical model in order to complete the scientific analysis. An analysis can be performed as part of a mathematical model.

- 5.15 Sensitivity – The degree to which the model results are affected by changes in a selected model input.
- 5.16 Software – Computer programs, procedures, rules, and associated documentation pertaining to the operation of a computer system.
- 5.17 Traceability – The ability to trace the history, application, or location of an item, data, or sample using recorded documentation.
- 5.18 Transparency – The attribute of producing documents that are sufficiently detailed as to purpose, method, assumptions, inputs, conclusions, references, and units, such that a person technically qualified in the subject can understand the documents and ensure their adequacy without recourse to the originator.

6.0 RESPONSIBILITIES

- 6.1 Responsible Manager (ORP Engineering Lead) is responsible for initiation of the Work Plan (WP) and coordination of the modeling and model validation process.
- 6.2 Originator (Ash Fall Project staff) are responsible for developing the models and the model report.
- 6.3 Ash Fall Project Quality Assurance (QA) Lead is responsible for reviewing the model report.
- 6.4 Independent Technical Reviewer (Ash Fall Project staff) is responsible for providing the technical review of the model report.
- 6.5 EMCBC Coordinator is responsible for collecting the QA records associated with the model efforts and report and processing the records in accordance with AFP-AP-20, *Quality Assurance Records*.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

7.0 GENERAL INFORMATION

Modeling, by its nature, is an iterative process. This procedure establishes those action steps that must be completed as part of this process. Generally, the action steps described in the following subsections must be completed in sequential order, however, this is not the case for all action steps. Specific action steps that must be completed before other action steps begin are identified.

8.0 PROCEDURE

8.1 Developing a Work Plan

- 8.1.1 The Responsible Manager obtains a document identifier from EMCBC Coordinator (Document Control) for the Work Plan (WP).
- 8.1.2 The Responsible Manager plans the modeling activity and documents the Work Plan (WP) using the outline in Attachment A, Work Plan Outline.
- 8.1.3 Where appropriate, the Responsible Manager assigns the task of preparing portions of the draft WP to other individuals with the appropriate technical expertise.
- 8.1.4 The Responsible Manager coordinates development of the WP with other organizations providing input to or using the results, as applicable.
- 8.1.5 The Responsible Manager determines which organizations should perform a review of the WP, but at a minimum includes an Independent Technical Reviewer (ITR) and QA.
- 8.1.6 The Responsible Manager initiates a review as follows:
 - 8.1.6.1 Prepares a review package that includes the draft WP, the completed AFP-AP-05, *Control of the Electronic Management of Information* evaluation, if applicable, and any pertinent background information or data that is not readily available.
 - 8.1.6.2 Initiates and process the review in accordance with AFP-AP-13, *Document Review*.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

- 8.1.6.3 In addition to the review criteria established in AFP-AP-13, *Document Review* includes the following criteria as a minimum:
- A. WP content complies with applicable sections of Attachment A.
 - B. Information in the WP is applicable to the WP's intended purpose.
 - C. Information in the WP is technically adequate and complete in the context of the WP's intended purpose.
 - D. Information in the WP is correct.
 - E. Results of activities described in the WP will be sufficiently accurate for their intended purpose and use.
 - F. Information has been integrated with other work, as applicable.
- 8.1.7 After completion of the review and comment resolution, the Responsible Manager:
- 8.1.7.1 Prepares the final version of the work plan and obtain appropriate approvals.
 - 8.1.7.2 Submits the approved WP to EMCBC Coordinator (Document Control).
 - 8.1.7.3 Submit the records in accordance with Section 9.0.

8.2 Developing a Model

- 8.2.1 The Responsible Manager assigns an Originator to perform the modeling activity.
- 8.2.2 The Originator conducts the modeling activity and associated tasks in accordance with the WP and all applicable procedures.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

- 8.2.3 The Originator obtains a document identifier (DI) for the model report from EMCBC Document Control in accordance with AFP-AP-14, *Document Control*.
- 8.2.4 The Originator documents the model using Attachment B, Model Report Outline.
- 8.2.5 The Originator ensures qualified software used to develop and perform the model is controlled and documented in accordance with AFP-AP-06, *Software Management Control*.
- 8.2.6 The Originator ensures unqualified data are qualified in accordance with AFP-AP-04, *Qualification of Unqualified Data*.
- 8.2.7 If data are obtained from outside sources that are not established facts, the Originator ensures these data are demonstrated to be suitable for the specific application. When appropriately justified, these data are considered qualified for use within the technical product. The extent to which these data demonstrate properties of interest shall be addressed. One or more of the following factors shall be used when presenting the case that data are suitable for intended use:
 - A. Reliability of data source
 - B. Qualifications of personnel or organizations generating the data
 - C. Prior uses of these data
 - D. Availability of corroborating data.
- 8.2.8 Ensure that validation of the mathematical model and its underlying conceptual model includes documentation of decisions or activities that are implemented to generate confidence in the model during model development, including the following.
 - A. Selection of input parameters and/or input data, and a discussion of how the selection process builds confidence in the model.
 - B. Description of calibration activities, and/or initial boundary condition runs, and/or run convergences, and a discussion of how the activity or

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

activities build confidence in the model. Include a discussion of impacts or any run non-convergences.

C. Discussion of the impacts of uncertainties to model results.

8.3 Model Validation

8.3.1 The Responsible Manager ensures that mathematical models and their underlying conceptual models undergo model validation activities after the model has been developed. Select a validation method from the following:

- A. Corroboration of model results with data acquired from the laboratory, field experiments, analog studies, or other relevant observations, not previously used to develop or calibrate the model.
- B. Corroboration of results with alternative mathematical models.
- C. Corroboration with information published in refereed journals or literature.
- D. Peer Review in accordance with AFP-AP-10, *Peer Review*.
- E. Technical review by reviewers independent of the development, checking, and review of the model documentation.
- F. Corroboration of abstraction or system model results to the results of the validated mathematical model from which the abstraction or system model was derived, including corroboration with results of auxiliary analyses used to provide additional confidence in system model results.
- G. Corroboration of pretest model predictions to data collected during subsequent, associated testing.
- H. Technical review through publication in a refereed professional journal or review by an external agency. (This approach must be used in combination with at least one other model validation activity from this list).

8.3.2 Document model validation as described in Section 9 of Attachment B.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

8.4 Model Review

- 8.4.1 The Responsible Manager assigns an Independent Technical Reviewer (ITR) and QA reviewer.
- 8.4.2 The Originator provides a copy of the model documentation and any other supporting documentation to the ITR and QA reviewers.
- 8.4.3 The ITR reviews the model documentation and model validation ensuring that:
 - 8.4.3.1 The content and output of the model are technically adequate, complete, and correct.
 - 8.4.3.2 Software, if used, is adequate for its intended use; is identified by the software tracking number, title, and revision/version number; and has been controlled and documented in accordance with AFP-AP-06, *Software Management Control*.
 - 8.4.3.3 Appropriate product inputs were selected, correctly identified in the model documentation and incorporated in the modeling activity.
 - 8.4.3.4 Corroborating data, models, or information is clearly identified.
 - 8.4.3.5 Any assumption, data undergoing qualification per AFP-AP-04, *Qualification of Unqualified Data* or other input values are clearly identified and justified.
 - 8.4.3.6 The implications of uncertainties and restrictions are discussed and are evaluated within the model documentation.
 - 8.4.3.7 The assumptions, constraints, bounds, or limits on the inputs are identified in the model documentation, and their impact on the results are described and assessed in the documentation.
 - 8.4.3.8 The discussion of scientific approach and/or technical methods is documented.
 - 8.4.3.9 The referencing is thorough, accurate, and complete.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

- 8.4.3.10 Data, information exchange drawings, and drawings used as input are verified to their home information system/controlled source.
- 8.4.3.11 Validation has been completed in accordance with the applicable WP and the requirements of this procedure.
- 8.4.3.12 Criteria for adequacy/accuracy are discussed and adequately documented.
- 8.4.3.13 An appropriate level of confidence, as identified in the applicable WP has been obtained.
- 8.4.3.14 Confidence building during model development as described in 8.2.8 is adequately documented.

8.4.4 The ITR documents comments in accordance with AFP-AP-13, *Document Review*.

8.4.5 The QA Reviewer performs a review to ensure compliance with this procedure and the applicable WP.

8.4.6 The QA Reviewer documents comments in accordance with AFP-AP-13, *Document Review*.

8.4.7 The Originator:

8.4.7.1 Addresses all comments and modifies the model documentation to incorporate comment resolution.

8.4.7.2 Provides the updated copy of the model documentation to the ITR and QA Reviewer.

8.4.7.3 Obtains comment resolution in accordance with AFP-AP-13, *Document Review*.

8.5 Final Products

8.5.1 The Originator:

A. Prepares the final model report and obtains the necessary approvals.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

- B. Submits the model report to Document Control in accordance with AFP-AP-14, *Document Control*.
- C. Submits the records in accordance with Section 9.0.

8.5.2 The Originator submits the following to the data tracking database in accordance with AFP-AP-03, *Data Control*.

- A. Product output that replaces or supersedes product output currently in the database.
- B. Data that have undergone a status change as a result of a qualification within the model documentation.

8.6 Model Changes

8.6.1 When initiating a change to the model report, the Responsible Manager:

- 8.6.1.1 Ensures the entire product is brought into compliance with the current version of the relevant procedures.
- 8.6.1.2 Ensure the model report is developed, reviewed, and approved in the same manner as the original report.

9.0 RECORDS

9.1 The approved document in its entirety shall be submitted by the EMCBC Coordinator to records in accordance with AFP-AP-20, *Quality Assurance Records*.

9.2 The following are considered Lifetime QA Records:

- Work Plan
- Model Report
- Review Documentation (generated in accordance with AFP-AP-13, *Document Review*).

10.0 FORMS USED

None.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

11.0 ATTACHMENTS

Attachment A – Work Plan Outline
Attachment B – Model Report Outline

Environmental Management Consolidated Business Center
Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

Attachment A – Work Plan Outline

Environmental Management Consolidated Business Center
Ash Fall Project

**Work Plan XXX
Revision XX**

Effective Date is 3 days after the date of approval

Prepared By: _____ **Date** _____
Robert Hasson
Ash Fall Project QA Lead

Approved By: _____ **Date** _____
Kelly Ebert
ORP Ash Fall Project Engineer

Concurrence: _____ **Date** _____
Ken Armstrong
EMCBC Assistant Director,
Office of Technical Support and Asset Management

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

1. Work Scope

Describe the scope of work:

- State the overall technical and/or performance objectives or requirements to be met by completion of the work. WPs may control a single activity or multiple related activities.
- Identify all major activities (primary tasks), including identification of scoping activities if used to assist in the development of the scientific approach or the choice of technical methods for activities described in the WP. Describe scoping activities as a separate section entitled Description of Scoping Activities. For those scoping activities that are carried forward into the technical product, ensure that adequate documentation is included to support the qualification status of the activities, as appropriate.

2. Approach/Technical Methods and Acceptance Criteria

- Model validation criteria for adequacy of scientific basis and accuracy for intended use shall be explicitly specified for ensuring the appropriate level of confidence has been obtained.
- Identify and provide justification for the model validation activity/activities to be completed during and after development of the model, dependent upon and consistent with the model's intended use and required level of confidence as described in Attachment B of this procedure.
- State the methods for determining the level of accuracy, precision, and representativeness of results of each activity.
- State applicable acceptance and/or completion criteria identified in higher level planning for each activity and product, including DOE acceptance criteria.

3. Industry Standards, Federal Regulations, and DOE Orders

- State applicable standards, including industrial and/or technical standards.
- State any sections or subsections of the Code of Federal Regulations, U.S. Department of Energy (DOE) orders, and/or regulatory requirements.
- Identify any derived requirements identified from other source documents.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

4. Implementing Documents

Identify the specific implementing procedure(s) that will be used to develop and review data (e.g., AFP-AP-04, *Qualification of Unqualified Data*, AFP-AP-21, *Laboratory Notebook Control*, etc.). It is not necessary to list support procedures used for procurement, calibration, corrective action, or processing the technical products, such as those used for document control and records management. To the extent foreseeable, identify any additional implementing documents to be developed to control and perform each activity.

5. Quality Verifications

Identify any quality verifications, other than surveillances or audits (i.e., mandatory hold points and readiness reviews) that are required during the execution of the WP.

6. Prerequisites, Special Controls, Environmental Conditions, Processes, or Skills

- Describe any prerequisites that must be satisfied before work begins, including receipt of data/input(s) under development. Identify the organizations responsible for developing the input(s).
- Document the results of the evaluation required by AFP-AP-05, *Control of the Electronic Management of Information* and the method(s) or the implementing documents to be used for control of electronic management of information.
- Identify any special training/qualification requirements for personnel performing the work activity.

7. Software

- Identify software to be used to conduct the work. Identify the associated software tracking numbers, if known.
- Indicate whether the software is qualified or unqualified.

8. Organizational Interfaces

Identify any organizational interfaces, including input and customer organizations, in addition to those internal to the implementing organization, and state their roles/responsibilities.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

9. Procurement

Provide a description of the procurement processes pertinent to the activity, if known.

10. References

List references as applicable, excluding those listed as Industry Standards, Federal Regulations, DOE Orders, and implementing documents.

Environmental Management Consolidated Business Center
Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

Attachment B – Model Report Outline

Environmental Management Consolidated Business Center
Ash Fall Project

Model XXX
Revision XXX
Title

**Originator
Printed Name**

**Originator
Signature**

Date

**ORP Ash Fall Project Engineer
Printed Name**

**ORP Ash Fall Project Engineer
Signature**

Date

**EMCBC Assistant Director,
Office of Technical Support
and Asset Management
Printed Name**

**EMCBC Assistant Director,
Office of Technical Support
and Asset Management
Signature**

Date

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

If any of the following sections are not applicable to a particular model, a brief statement of non-applicability is required for documentation purposes under that particular heading (i.e., Quality Assurance, Use of Software, etc.). The document may include additional sections (e.g., an Executive Summary) to assist users of the model. Information presented in the model documentation shall be transparent and traceable. Document any deviation from the Work Plan in the appropriate section and provide justification for the deviation.

- 1. Purpose** – This section shall provide the intended use of the model, the model limitations (e.g., data available for model development, valid ranges of model application, spatial and temporal scaling), and scope of the model documentation. It shall also refer to the Work Plan for the activity.
- 2. Quality Assurance** – This section shall include the applicability of the QA program, including evaluation of associated activities in accordance with appropriate implementing procedures. This section shall identify the methods used to control the electronic management of data in accordance with the controls specified in the Work Plan and will describe any variance from the planned methods.
- 3. Use of Software** – This section shall identify all controlled and baselined software used in model development, performance, and validation. Document the use of the software, including the software name, tracking number, version, operating environment (including platform and operating system), and range of use. Discuss why the software was selected and describe any limitations on outputs due to the selected software. Document that the use of the software was consistent with the intended use and within the documented validation range of the software. Software shall meet the requirements of AFP-AP-06, *Software Management Control* unless exempted from qualification by that procedure.

If the solution to the calculation or analysis used to support the product is obtained using the standard functions of a commercial off-the-shelf software program (e.g., Excel, EarthVision) and the results are not dependent on the software program used, this software does not need to follow the requirements of AFP-AP-06, *Software Management Control*. In these instances, the actions performed below shall be documented in sufficient detail to allow an independent reviewer to reproduce or verify the results by visual inspection or hand calculation without recourse to the Originator.

- The formula or algorithm used
- A listing of the inputs to the formula or algorithm
- A listing of the outputs from the formula or algorithm
- Other information (e.g. operating environment information) that would be required in order for any independent person to reproduce the work

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

4. **Inputs** – Reference all project data by Data Tracking Number (DTN). Product inputs shall be correctly selected, identified in the model documentation, correctly cited and incorporated. Document and substantiate the appropriateness of product inputs. Document confirmation that data used to develop the model are not used to validate the model.
5. **Criteria** – List criteria identified in the Work Plan, including requirements contained in applicable requirement documents and any relevant acceptance or completion criteria. Model validation criteria should be documented in Section 8 of the model report.
6. **Codes, Standards, and Regulations** – Identify all the applicable codes (only if the model directly addresses federal or other code requirements), standards (e.g., American Society for Testing and Materials or Occupational Safety and Health Administration standards), and regulations used in the model by name, number, and date, including applicable revision status, using date or revision designator.
7. **Assumptions** – This section shall include a description of the assumptions used, in the absence of direct confirming data or evidence, to perform the model activity.
8. **Model Discussion** – Include a description of the system, process, or phenomenon conceptual model and scientific, engineering, and mathematical concepts/principles on which the mathematical model is based. Establish the appropriateness of the model for the purposes and within the limitations stated in Section 1 of the report. Include a discussion regarding implementation of the requirements specified in Section 6 and a justification for deviation from any of those requirements.

Identify all the corroborating/supporting data, models or product output used to develop the model. Identify the sources of the corroborating/supporting information. Include additional discussions to substantiate input used in this section if not included in Section 4. Include additional discussion to substantiate input used in this section. Address any differences in direct input values between values brought forward in Section 4 and values used in this section. This information may be provided in tables, lists, or text discussing model development as long as the above provisions are met.

The following topics shall be included in this section, as applicable, when documenting a model:

- A detailed description of the conceptual model and the conceptual model implementation (mathematical model)
- Description of the mathematical model, generally expressed in the form of relevant governing equations.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

- Description of the numerical model, including analytical or numerical methods, solution technique, and numerical grid, as appropriate.
- Results of literature searches or other background information.
- A discussion on constraints or limits on inputs and any impacts on model outputs.
- Identification that all input ranges are within the range of validity of the model or a justification if they are not.
- A discussion of uncertainties, sources of uncertainties, and impacts of uncertainties on model output.
- Alternate models that were not used and the rationale for not selecting them.
- Units of measurement.
- Identification of any conservatisms used and demonstration that other approaches were not feasible.
- Description of the input data used to generate input files for each model simulation.
- A discussion of initial and/or boundary conditions.
- A discussion of model assumptions, mathematical formulations, equations, algorithms, and numerical methods used.
- A discussion of the results of model testing, sensitivities, and calibration activities.
- Intended use of the model output.
- Comparison between the preliminary and final outputs, as applicable.
- Other software/computational methods considered and the rationale for not selecting them.

9. Validation – The model validation documentation shall include:

- Identification of corroborating/supporting data, models or information used to complete model validation activities. Identify the sources of the corroborating/supporting information.
- Level of model importance and required level of confidence.
- Verification and justification that an adequate approach was taken during model development.
- Documentation and discussion of model validation activities performed.
- Results of validation activities.
- Model validation criteria explicitly specified for ensuring the appropriate level of confidence has been obtained, consistent with this procedure and the Work Plan. These criteria must address adequacy of the scientific basis and accuracy of the model.
- Text demonstrating that validation criteria are met consistent with the stated level of confidence required for the model.

Environmental Management Consolidated Business Center Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

- Any future activities that need to be accomplished for model validation and a justification for extending model validation beyond the documented completion of the current model.
10. **Conclusions** – Provide a summary of the modeling activity. The conclusions, including the DTNs and product output as well as any decisions or recommendations based on the modeling activity, shall be presented in this section. Conclusions shall include any uncertainties and restrictions for subsequent use.
 11. **Inputs and References** – Sources of inputs, software, DTNs, and cited references shall be provided in this section. Inputs and references include materials that support the conclusions of the model. These may include published reports, technical papers, laboratory notebooks, literature searches, or other information.
 12. **Appendices** – Supporting documentation, such as computer output, that are lengthy or cannot be conveniently included within the main text of the documentation may be included as appendices. Computer output may be attached as a hardcopy, read only disk, or compact disk (read only), but must meet the requirements of AFP-AP-20, *Quality Assurance Records*. Computer output files included as appendices are exempt from page numbering, document identifier, and revision number requirements provided the total number of pages in each appendix (for hardcopy) or complete file information, including all file names, file dates and times, and file sizes, are documented in the appendix.

Environmental Management Consolidated Business Center
Ash Fall Project

Model Validation

Procedure: AFP-AP-07
Revision 0, 02/28/16

Form 12-1 – Record of Revision

DOCUMENT: AFP-AP-07, *Model Validation*

Revision Number	Description of Changes	Revision on Pages	Effective Date
0	Initial Issue	All	02/28/2016