GEOSCIENCES AND ENGINEERING DIVISION QUALITY ASSURANCE PROCEDURE	Proc. QAP–014 Revision 3 Chg 0 Page 1 of 4

Title: **QAP–014 DOCUMENTATION AND VERIFICATION OF SCIENTIFIC AND ENGINEERING CALCULATIONS**

EFFECTIVITY AND APPROVAL

Revision 3 of this procedure became effective on 8/25/2005. This procedure consists of the pages and changes listed below.

Page No.	Change	Date Effective
All	0	8/25/2005

Supersedes Procedure No. QAP–014, Rev. 2 Chg 2, dated 7/28/2004

Prepared by	Date	Approved by	Date
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QAP–014 DOCUMENTATION AND VERIFICATION
OF SCIENTIFIC AND ENGINEERING CALCULATIONS

1. PURPOSE

The purpose of this procedure is to specify the Geosciences and Engineering Division (Division) methods for documenting and verifying scientific and engineering calculations. This procedure applies to calculations performed by hand, hand calculator, or computer software.

2. RESPONSIBILITIES

2.1 The investigator is responsible for documenting calculations as specified in this procedure.

2.2 Technical reviewers are responsible for verifying calculations as specified in this procedure.

3. PROCEDURE

3.1 Documenting Calculations

Calculations shall be documented in appropriate scientific notebooks or in the reviewed document (i.e., a technical report) in sufficient detail so that the calculations and results can be reproduced.

3.1.1 The required documentation for various calculation methods is specified in Table 1.

3.1.2 If the output data consist of large files, the files may be copied to electronic media and attached to the scientific notebook, or the scientific notebook may reference a file location. Electronic output files from computer runs should identify the software name, version, and date of the calculation.

3.2 Verifying Calculations

3.2.1 The objective of verifying calculations is to assure their arithmetic correctness. When preparing a document for review in accordance with QAP–002, Review of Documents, Reports, and Papers, the manager responsible for the document will determine whether a product contains calculations and the extent to which these calculations require verification. The manager will make this decision based on (i) potential importance of the calculations with respect to their intended use, (ii) extent of prior verification in related reports or papers, and (iii) complexity of calculation and potential for errors. By checking the appropriate blocks of the Instructions to Technical Reviewers (form QAP–12) the manager shall identify the extent and type of over checks required

based on the calculation methods used. Rationale shall be provided to justify when calculation over-checks are not required.

3.2.2 When calculation verification is required in the Instructions to Technical Reviewers form, the technical reviewer shall obtain access to relevant scientific notebooks and records of input and output data files, as necessary. As applicable, the technical reviewer may require access to the software used to perform the calculation and exercise the software as a part of the verification process.

3.2.3 The technical reviewer shall verify that input data, calculation methods (i.e., software identification and version), and output data have been documented as required in Table 1.

3.2.4 The technical reviewer shall verify the calculations using the methods specified in Table 1 for the calculation method used.

3.2.5 Calculation verification shall be documented as part of the technical reviewer comments on the form TOP–3 Report Review/Comment Resolution Record. The technical reviewer shall indicate how the verification was accomplished and the conclusions regarding the correctness of calculations. The technical reviewer should identify the software used (when applicable), the software control and validation status, and the location of the calculation documentation (i.e., scientific notebook number).

3.2.6 If calculation errors are found during the technical review, the calculations and affected portions of the report shall be corrected before the product is released.

4. RECORDS

Report review/comment resolution sheets shall be retained as quality assurance records in accordance with QAP–012, Quality Assurance Records Control.

Table 1

Calculation Method	Required Documentation	Required Verification
Using Controlled Software	Name and version number of the controlled software Input files Output files	Check a sample of the input data to determine that data are correctly entered and are free of errors (e.g., incorrect units, misplaced decimal, incorrect exponent, value in the wrong field, etc.). Check a sample of the output for reasonableness.
Using Uncontrolled Software	Copy of the source code or executable code of the uncontrolled software (submitted in the quality assurance record package for the technical document). Input files Output files	Check a sample of the input data to determine that data are correctly entered and are free of errors (e.g., incorrect units, misplaced decimal, incorrect exponent, value in the wrong field, etc.). Check a sample of results by alternate calculations either by hand, by using alternate software, or by reviewing the basic logic of the uncontrolled software. The reviewer may ask the assistance of the report author(s) in operating the software.
Using Commercial-Off-the-Shelf Software	Name and version number of the commercial-off-the-shelf software (e.g., spreadsheets, Mathematica, Mathcad). Source code or description of any macros, formulae, or scripts, as applicable. Input data Output data	Check a sample of the input data to determine that data are correctly entered and are free of errors (e.g., incorrect units, misplaced decimal, incorrect exponent, value in the wrong field, etc.). Check a sample of the formulae employed. Check the reasonableness of a sample of the output.
Other Calculations (Hand, Hand Calculator)	Description of the calculation method in detail sufficient for reapplication. Input data Output data	Check correctness of a sample of the input data. Check a sample of results by alternate calculations.