



SOFTWARE PROGRAM CALCULATION VERIFICATION METHODOLOGY


BGS-IM-02

Revision 1

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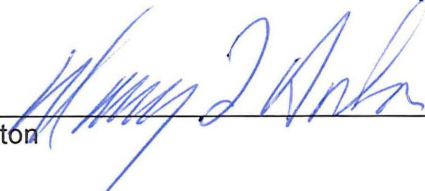


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03/25/2016

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3/25/2016

Effective Date: 03/31/2016

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Revision History

Rev. #	Date	By	Type ¹	Changes
0		D. Newton	N	Initial Issue
1	03/25/2016	D. Newton	M	Revised to address CARs: 15-16a #1. Revised to address CAR: 15-22. Section 1: Clarify use of procedure. Section 3: Change BGS-QA-05 to BGS-AD-01. Section 3: Change BGS-QA-17, <i>Records Management</i> to BGS-RM-01, <i>Quality Assurance Records</i> . Section 6, 7.1.1., 7.2.2.: Remove Software/Application Engineer. Section 8: Remove references to "Non-Nuclear" and "Nuclear".

¹ M = major change, mc = minor change, N = new

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1. PURPOSE

This procedure is a one-time use procedure that will be used to generate a gap analysis for Radiological Packaging Determination and Classification (RADCALC) test coverage, to identify RADCALC algorithms/equations, to perform calculations to verify the identified RADCALC algorithms/equations, and to create the expected results for the RADCALC test cases.

This procedure provides the method and format for preparing, checking, approving, revising, filing, and retaining software program calculations. A calculation in this procedure is considered to be any type of technically required mathematical computation in which the results are used in a software program design, test plan/report, evaluation, or work activity that is performed or used by personnel.

2. SCOPE

This procedure applies to all software program calculations prepared or revised by BGS personnel for RADCALC.

3. REFERENCES

BGS-QAP-01, *Corporate Quality Assurance Program Plan*

BGS-AD-01, *Document Preparation and Control*

BGS-RM-01, *Quality Assurance Records*

4. DISCUSSION AND OVERVIEW

This document provides a process for performing hand calculations in support of the RADCALC project and to establish a baseline for new RADCALC versions. The term “baseline” in this context is defined as a series of test cases used to confirm that system or application outputs match the correct values established by hand calculations. The formation of a baseline effort should include at a minimum the following steps:

- 4.1 Review the test cases and categorize them to determine the experience level necessary to baseline each test case.
- 4.2 Evaluate the existing test cases to determine those which require a hand calculation and verify that the criteria used in the test case are correct.

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5. DEFINITIONS AND ACRONYMS

Alternate Calculation	A calculation prepared independent of the parent calculation for the purpose of confirming the parent calculation. An alternate calculation is prepared during the checking process, typically by the parent calculation Reviewer.
Approver	An individual that reviews the calculation to determine calculation completeness, accuracy, and conformance with design practices and procedure requirements.
Baseline	A specification or product that has been formally reviewed and agreed on, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures.
Checker	An individual different from the originator, qualified to originate the calculation, who performs a check of the calculation for technical accuracy. This may be performed by a review of the original calculation or by performing an alternate calculation.
Committed Calculations	Calculations that form the basis of specifications or other design documents used to provide the design basis for change to an existing software program. These calculations may be revised.
DCA	Document Control Administrator
Functional Manager (FM)	BGS personnel responsible for the functional area. (e.g., President, Project Manager, QA Manager)
Minor Change	Changes to a document that affect a process within the document, the basic content, or a major change in concept.
Originator	An individual qualified to perform original analysis, computations, and draw conclusions concerning the problem, based on education, training, and/or experience within a particular discipline.
Parent Calculation	A calculation in which other calculations depend upon.
Preliminary Calculations	Calculations made for estimates of performance, costs, or scale which are not performed with the intent of being directly incorporated in final test plans. They may include calculations to be incorporated in cost studies, bid specifications, or as estimates in reports. Preliminary calculations may form the basis for preliminary software design documents.

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RADCALC	Radiological Packaging Determination and Classification
Reviewer	An individual different from the originator, qualified to originate the calculation, who performs a check of the calculation for technical accuracy. This may be performed by a review of the original calculation or by performing an alternate calculation.
RMS	Records Management System
Software Engineer	A person appointed by the BGS Functional Manager to be responsible for the technical aspects of a project or operations and for providing review and approval authority for their project or operations.
Software Program Calculations	Calculations that are created by software applications.
SRS	Software Requirements Specification
Superseded Calculations	Calculations voided by general revision, change of criteria, or any other reason.
Test Case Calculations	A test case specific to a software program calculation.
Test Cases	A test case is used for a singular test scenario that identifies test data, procedures or inputs, scenarios, expected results.
Test Plan	A document describing the scope, approach, objectives, resources, and schedule of a software testing effort. It identifies the items to be tested, items not be tested, who will do the testing, the test approach followed, what will be the pass/fail criteria,
Test Procedures	A standardized sequence and documented process for performing a test.
Test Reports	A document that records data showing the comparison of test results with test objectives from a test plan.
Unverified Assumption	An assumption used in the calculation which must be verified before the calculation can be used as a committed calculation.

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6. RESPONSIBILITIES

This section contains the description of roles and responsibilities for key personnel associated with this procedure.

6.1 Functional Manager (FM) Responsible for the Calculation Activity

6.1.1 Appoints qualified calculation originators and reviewers.

6.1.2 Approves calculations.

6.1.3 Identifies work processes for calculations, and documents calculations in accordance with this procedure.

6.1.4 Ensures documentation of approved calculations are submitted to the Document Control Administrator (DCA) for inclusion in the Records Management System (RMS), when required.

6.2 Originator

6.2.1 Generate, processes, and documents the calculation.

6.3 Reviewer

6.3.1 Reviews the calculation to verify correctness, completeness, and conformance with design that are in accordance with the scope specified by the Software Engineer or by the FM.

7. PROCEDURE

7.1 Calculations Preparation by BGS Personnel

7.1.1 The FM assigns an originator competent in the subject matter of the calculation.

7.1.2 The originator determines the calculation type (preliminary or committed). Once the calculation type is determined, the originator prepares the calculation(s) using a BGS document generic cover page obtained from BGS-AD-01, *Document Preparation and Control*, which identifies the test case supporting the calculation and ensures the following:

- The calculation was prepared in a manner that produces a legible, reproducible document of sufficient contrast.
- Each page (including intentionally left blank pages) is designated with the test case calculation title, revision number, and page number. Attachments and addendums may be numbered separately.

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- The revision designator shall be “A” on the first issue of a preliminary calculation; on a committed calculation, it shall be “0”. All pages shall be assigned individual page numbers (the cover page is typically unnumbered).

7.1.3 The originator ensures calculations are orderly and complete and at a minimum includes the following:

- a) Reference the test case and test plan that the calculation supports.
- b) Reference to the verification of software program code.
- c) A concise statement of the purpose for the calculation.
- d) All input data including their source and the revision number of the data.
- e) Assumptions are clearly stated (note if the assumption is unverified).
- f) If there are limitations on the use and applicability of the calculation, include a list of the limitations and the conditions that must be satisfied in order for the calculation results to be valid.
- g) A list of references with their exact title and revision or version number, including process knowledge, drawings, codes, standards, and the computer program used.
- h) Calculations must be sufficiently clear to permit verification.
- i) Equations shall be stated for manual computations. If spreadsheets are used for computations, the associated equations must be stated or identified in the calculation package.
- j) Numerical calculations shall include the identification of the units used.
- k) Concise statements addressing the calculation results, recommendations, limitations, and conclusions.
- l) For computer generated calculations, provide the computer input files by including a hardcopy printout or a set of read-only files to be included with the calculation files. Any software to perform calculations or verify the calculations may be subject to BGS-SQ-02, *Software Management*.
- m) A table of contents for complex calculations.
- n) Signature page for originator, reviewer, and FM.

7.2 Generate Test Case Gap Analysis

7.2.1 Compare the existing system or test plan against the Software Requirements Specification (SRS) to determine the extent to which the test plan addresses the requirements.

7.2.2 For every requirement that is not addressed by a test case, generate a test case that includes expected results and/or acceptance criteria. The

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expected results/acceptance criteria are generated through performing calculations to verify the algo/equations coded in the software application.

7.3 Calculation Checking

7.3.1 A review is required for all calculations. The review is required to be performed by someone other than the originator who is qualified to have originated the calculation.

7.3.2 The originator submits calculations to the FM to identify a reviewer.

7.3.3 The FM assigns an individual (someone besides the originator) to be the reviewer who has not been involved in the preparation of the calculation and has sufficient qualifications to have originated the calculation.

NOTE: Alternate calculation methods do not require checking.

7.3.4 For an alternate calculation method for comparison of results to the original calculation, then the reviewer will perform the following:

- a) Attach alternate calculations used for checking to the original calculation.
- b) Number each page independently of the calculation being checked, sign as "originator" for the alternate calculation, and note on the cover page the calculation being checked.
- c) Alternate calculations be prepared in accordance with the preparation of the original calculations. At a minimum, input data references, clearly stated assumptions, sufficiently clear calculations, and documented equations.

7.3.5 For other than an alternate calculation method, the reviewer will perform the following:

- a) Review calculation input to verify conformance with specific project conditions.
- b) Review validity of assumptions, appropriateness of analytical methods and judgment, attainment of required mathematical accuracy, compliance with design criteria, completeness, and reasonableness of output data.
- c) Sign the calculation cover page. If applicable, the initialed alternate calculations shall be attached. If multiple reviewers are used on a calculation, the reviewers shall identify which portions of the calculation they checked (e.g., initial individual calculation pages or identify on cover page).

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- d) Check computer calculations to ensure that the computer programs meet the requirements of this document.
- e) Verify that the computer program is appropriate and has been authorized for use on the project by referencing the Controlled Computer Software Log.
- f) Verify that the reference documents for input values are available and are appropriate for use in the calculation.

7.3.6 Return calculation to the originator with any comments.

7.3.7 The originator will resolve the reviewer's comments.

- a) Comments that cannot be mutually resolved by the originator and reviewer are forwarded to the FM for resolution.

7.4 Calculation Approval

7.4.1 The originator submits checked test case calculation(s) to the FM.

7.4.2 The FM reviews the calculation(s) to determine calculation completeness and conformance with design practice and procedure requirements.

7.4.3 The FM returns the calculation(s) to the originator with any comments.

7.4.4 The originator resolves the comments and returns the calculation(s) back through the reviewer and review cycle, as required.

7.4.5 The originator, reviewer, and FM approve the test case calculation(s) and sign and date the test case cover page.

7.4.6 The FM ensures the document contains required signatures and printed names.

7.5 Management of Approved Calculations

7.5.1 Approved calculations will be included in the test plans supporting the program.

7.5.2 If a computer program was utilized in the preparation of the test case calculation, provide either a hardcopy printout of the input file or a set of read-only input files with the test case calculation(s). The computer program is subject to BGS-SQ-02, *Software Management*, prior to acceptance for use.

7.5.3 If references are not readily available, provide copies of the pertinent sections of the references as a .pdf file along with title and author.

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7.5.4 The FM incorporates the test case calculation(s) into the test plan and/or submits the test case calculation(s) to the DCA per Section 8.0 of this document.

7.5.5 The FM provides an electronic copy of the test case calculation, in the native file format when possible, to the DCA for inclusion into the RMS. If the native format is not a standard BGS application (such as Microsoft Word or Excel), provides a .pdf file of the entire calculation.

7.6 Revisions

7.6.1 Revisions are prepared, checked, reviewed, and approved in the same manner as a new calculation with the addition of the steps included in this section of the procedure.

7.6.2 The revision must be identified in one of the following ways:

- a) Revision bars or other graphically indicated changes in the calculation,
- b) An addendum with the changes and a description of changed content; the numbers of the pages that changed, or
- c) A description of what changed, and replacement pages, to be included in the total package, for the pages that changed.

7.6.3 The assigned originator requests the latest revision of the original calculation from the DCA.

7.6.4 The originator identifies revisions to completed calculations as follows:

- a) Preliminary calculations should be given "letter" revision designators. Committed calculations should be given "numeric" designators. When a preliminary calculation is converted to a committed calculation, the revision letter should be changed to a number, starting with 0.
- b) When graphically indicating changes, the change indicators from previous revisions should be removed. Revised portions will be identified (e.g., vertical revision bars for text) adjacent to the revised portions. The letter or number designator for this revision should be noted adjacent to the calculation number provided on each calculation page. The updated revision letter or number and revision date should be shown only on each revised page.
- c) Revisions may require the addition of new calculation pages or deletion of existing pages.
- d) The addition of pages to a completed calculation should be by revision. The added pages shall be identified with the new revision designator. The added pages that must be inserted between existing pages shall be numbered by an alphanumeric system. This system shall identify the additional pages by using the number of the existing page that

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precedes the additional pages plus an alphabetic character (e.g., pages 7, 8, 8A, 8B, 8Z, 9 where pages 8A, 8B, 8Z are the added pages).

- e) All calculation pages affected by the revision should be identified on the document cover page.
- f) If the original calculation cover page is not available to revise, replace the previous revision signatures and dates with typed information.
- g) Minor changes may be made on the original calculation pages by lining out, initialing, and dating the portion being revised. The revision bars “|” shall be used. The use of white-out or correction tape is not permitted. The information from preceding revisions, except the revision bars, shall not be erased.
- h) When a revision is made, the checker and FM are required to follow all the steps in this procedure for the revised portions of the calculation.

7.7 Computer Program Calculations

7.7.1 When using a computer program for the calculation, include the following in the calculation package:

- a) Inputs and outputs.
- b) Identification of the computer program by name.
- c) Version/release used.
- d) Specifications on the computer or workstation used.
- e) Options used, if the program permits multiple options. If default options are used, a justification should be stated.

7.7.2 When a front-end validation program is used, include a statement confirming that this method was employed and was successful.

7.7.3 When test problems are used, include a description of the problems, the results obtained, and a statement regarding their acceptability. The problems may be either a confirmed published experiment or test, a standard problem with known documented solutions, or confirmed published data and correlations.

8. RECORDS

Calculation results will be included in the test reports. If test case calculations are not included in the test plan, they shall be submitted as QA records as per BGS-SQAP-01, *RADCALC Software Quality Assurance Plan*.