

Project Management Plan

For

Subsurface Transport Over Multiple Phases (STOMP) Software Maintenance and Development

(Intended for Inclusion by Reference in Applicable PMPs)

Sector(s):

Product Line(s):

Software Configuration Manager: Mark D. White

Product Line Manager(s): Charlie Brandt

This plan is intended to serve for the remainder of the STOMP software life cycle. Any project that implements, maintains and/or development of STOMP may reference this PMP in that project's PMP, rather than addressing the software on a project by project basis. Changes in scope, schedule, Software Configuration Manager, or funding will be reflected in a revision. A revision history will be maintained with this plan. Copies of this document are provided to all staff involved in code maintenance or development during the STOMP software life cycle.

Software Configuration Manager Signature: _____ **Date:** _____

Quality Engineer Signature: _____ **Date:** _____

Lead Product Line Manager Signature: _____ **Date:** _____

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PMP Revision History

Revision #	Comments	Authors	Revision Date	Effective Date
0	Initial Project Management Plan Release	W. Nichols	21 Dec 2006	1 Jan 2007
1.0	Editorial revisions	V. Freedman	18 Jan 2007	18 Jan 2007

Project Management Plan

1.0 Introduction

This Project Management Plan (PMP) describes the management methods, organization, control systems, and documentation for the maintenance and further development of the STOMP software. If significant changes occur during the life cycle of this software, this PMP will be revised.

The purpose and intended use of the STOMP software is to produce numerical predictions of subsurface flow and transport phenomena in variably saturated subsurface environments, which are contaminated with volatile or nonvolatile organic compounds or radionuclides including radioactive chain decay processes.

STOMP is custom-developed software. It has been under development and in use by Pacific Northwest National Laboratory since 1993. This software is versatile, and has been used by numerous projects inside PNNL as well as by external agencies. Short courses have been offered in North America and Europe for users of STOMP outside PNNL.

The Subsurface Transport Over Multiple Phases (STOMP) software is a versatile engineering simulator for multiphase porous media transport that is used across a number of projects. Because this versatile software package is implemented in several projects, and its software life cycle is significantly longer than the duration of any single project that contributes to its maintenance or development, this Project Management Plan (PMP) has been developed specifically to address the maintenance and future development of the STOMP code apart from any single project that funds such work. Any project that implements, maintains and/or development of STOMP may reference this PMP in that project's PMP, rather than addressing the software on a project by project basis. This approach will assure continuity of software configuration control throughout the remainder of the STOMP software life cycle.

The STOMP software is not a single program. Instead, it is comprised of several "operational modes" that are constructed by connecting specific code modules available in the STOMP source repository to couple specific governing equations. For example, if single-phase water flow will be simulated, then STOMP operational mode 1 (STOMP1) is the appropriate operational mode and is constructed with the source code necessary to solve the partial differential equations that govern the conservation of water mass and dilute species transport. If two-phase flow in both aqueous and gas phases is to be simulated, then STOMP operational mode 2 (STOMP2) is the appropriate operational mode and is constructed with the source code necessary to solve the partial differential equations that govern the conservation of water mass, air mass, and dilute species transport. Other operational modes cover coupling conservation equations for salt mass, energy, carbon dioxide, ice, oil, etc. Each operational mode must be separately qualified.

1.1. Project Scope

The objective of this PMP is to provide overall direction for the maintenance and continued development of the STOMP software by multiple PNNL projects. It is expected that any project that uses, maintains, and/or expands the STOMP software will address software use in the Electronic Prep & Risk (EPR) form for that project.

1.2. Deliverables and Schedule

Key deliverables and milestones for initial qualification of the STOMP software in keeping with DOE Order 414.1c are shown in the table below. Additional schedule related to future STOMP development will be reflected in the PMPs of those projects that fund such development.

Qualification Start Date: October 1, 2006 Planned Completion Date: January 1, 2007

Deliverables	Due Dates	Milestones	Due Dates
Project Management Plan	Feb 28 2007	STOMP Qualified as Safety Software, Grading Level C	Jan 1 2007
Software Requirements Specification	Feb 28 2007		
Software Requirements Traceability Matrix	Feb 28 2007		
Software Design Description	Feb 28 2007		
Software Test Plan	Feb 28 2007		
Software Test Results	Feb 28 2007		
Software Acceptance Report	Feb 28 2007		

It is anticipated that subsequent qualification of revised operational modes or modes not qualified by January 1, 2007 will be funded by projects that use and extend STOMP capabilities, and will be documented in the PMP of such projects.

1.3. Budget

PNNL management will fund initial qualification as Safety Software, grading level "C" to support the software as a general resource to multiple projects. It is expected that subsequent maintenance and development will be funded by those projects that use, maintain, and extend the development of the STOMP software.

2.0 Roles, Responsibilities, Accountabilities, and Authorities

The Laboratory's standard roles, responsibilities, accountabilities, and authorities ([R²A²s](#)) for project managers and staff apply to this project.

The Software Configuration Manager for the STOMP software is Mark White. PNNL's quality organization has identified Carrie Carlson to serve as the Quality Engineer for the STOMP software. The following table identifies project software maintenance team members.

Key Staff for STOMP Software Maintenance

Role	Staff	Responsibilities
Software Configuration Manager	Mark White	Decision authority to approve software changes
Software Custodian	Mark White	Software preservation (backup); software configuration management record keeping; source control
Software Developers	Mark White, Mart Oostrom, Mark Rockhold, Diana Bacon, Yilin Fang, Mark Williams	Software source code development
Software Testers	Yousu Chen, Fred Zhang, Vicky Freedman	Software testing

3.0 Administrative Controls

This section describes how the projects will manage communication and disposition of records at the end of the software life cycle.

3.1. Communications

The Software Custodian is responsible for assuring that software changes and status are communicated to the Software Configuration Manager, software users, software developers, and software testers in accordance with requirements in the STOMP Software Configuration Management Plan.

The Software Configuration Manager is responsible for timely communication of training requirements, risks/hazard exposure, and assignment of commitments/performance of software development and testing staff.

If adverse impacts to completed, reported software calculation results are discovered, the Software Configuration Manager will investigate the impact of the error, and if found consequential, report the error and impact to the concerned Project Manager(s) and Product Line Manager(s).

3.2. Software Life Cycle End

When the determination is made that the STOMP software life cycle is completed, all software maintenance and development records will be turned over to DOE records retention. Other closeout activities may be identified at the time the software life cycle ends. The Laboratory's intellectual property office will be notified that the code will no longer be supported.

4.0 Risk Management

All work will be performed in accordance with applicable requirements defined in the SBMS. The specific risks for this project, including corporate risk, customer quality risk, environment safety & health risk and safeguards and security risk will be more specifically addressed by the PMP of each project that uses, maintains, or further develops the STOMP software.

There are specific risks and hazards that pertain to the maintenance and development of the STOMP software that are identified here, along with the planned means to manage and mitigate these risks and hazards. The primary risk posed by use of this software is that a mistake in the

software design or implementation could result in the calculation of an erroneous result, resulting in one or more of the following undesirable outcomes:

1. For projects in progress, adverse impacts to project budget and schedule as corrections are made and calculations repeated to correct the mistake.
2. For completed projects, invalidation of regulatory products (e.g., Environmental Impact Statements, License Applications, or Composite Analysis) that rely on the calculations performed with the software.
3. Damage to the reputation of the Laboratory.

STOMP software is widely adopted and applied both in and out of the Laboratory, at Hanford and at other sites worldwide. Therefore the quality of the software is expected to be above reproach. Every effort must and will be undertaken to minimize the adverse outcomes identified above.

The primary means to minimize the risk of a software error of consequence are:

- Strict adherence to a STOMP Software Configuration Management Plan,
- Strict adherence to the STOMP Software Test Plan, and
- Timely identification, response, and communication regarding software errors and anomalies discovered by PNNL staff involved in use, maintenance, and development of the STOMP software.

5.0 Quality Assurance Planning

This section describes the project specific planning, execution, assessment of work and controls necessary to provide products/solutions and services of the highest quality consistent with project risks, [Battelle Policies and Standards](#) and the needs, expectations, and resources of the customer.

The STOMP software will be qualified and maintained in accordance with the [Safety Software](#) subject area of the PNNL Standards Based Management System that implements DOE Order 414.1c and NQA-1. It will be maintained in accordance with the STOMP Configuration Management Plan.

Typically, a project tasked with developing new software would follow the guidance in the Safety Software Subject Area to ascertain the software is considered Safety Software, and if so then to determine the type of safety software (grading level A, B, or C) which in turn determines the rigor applied to software documentation. In this case, the objective is to qualify, maintain, and provide the STOMP software as Safety Software, with grading level C (Safety and Hazard Analysis Software), as defined in the Safety Software Subject Area definition:

Safety and Hazard Analysis Software and Design Software. Software that is used to classify, design, or analyze nuclear facilities. This software is not part of a structure, system, or component (SSC), but helps to ensure the proper accident or hazards analysis of nuclear facilities or an SSC that performs a safety function.

PNWD Clarification: This is software that is typically used to classify, design, or analyze a DOE nuclear or radiological facility or site involving radiological hazards. This software helps to confirm the proper accident or hazards analysis of a facility. In this definition, the term facility has a broader definition than some may assume; it can refer to an entire DOE site, large operating areas within a site, individual buildings or laboratories, waste storage areas, and other types of locations that may contain radiological materials. This type of safety software is defined as Safety and Hazard Analysis Software and Design Software. (Examples include GENII, MCNP, etc.)

The rationale for identifying STOMP *a priori* both as Safety Software and as Safety and Hazard Analysis (Level C grading) software is that it has been and is expected to continue to be used for prediction of migration of radiological contaminants at DOE owned facilities. This makes the Safety Software Subject Area applicable for such applications.

Because STOMP is comprised of several operational modes, each possessing unique code module combinations and coupling and a unique main program element, qualification will be done on an operational mode basis. The code version and operational modes currently qualified will be distinguishable from those that are not yet qualified as Safety Software, Grading Level C.

This software maintenance and development activity shall comply with the applicable requirements in SBMS using a graded approach outlined in the PMP as the method to meet the requirements outlined in the Laboratory's DOE approved [Quality Assurance](#) Program. Details of this project's approach to assuring quality are contained in the following subsections of this PMP.

This PMP as a whole establishes the management processes, including planning, scheduling/execution, assessing, corrective actions, and providing resources for work to provide project deliverables based on risk, safety, software life cycle, complexity and quality requirements.

The established organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing work necessary to support project quality assurance and control based on the level of risk identified for the project are identified in Section 2.0 of this PMP.

5.1. Personnel Training and Qualification

The Software Configuration Manager shall ensure that only personnel who are knowledgeable and possess adequate technical skills to perform all their assigned tasks may fulfill software development or maintenance tasks. The Software Configuration Manager will identify any additional specific software maintenance tasks that will require staff training and changes managed in accordance with the [Training Design, Development, Implementation and Evaluation](#) subject area. The funding project shall maintain training documentation for STOMP users, including project-required coursework or on-the-job training taken by staff that is not capable of being tracked in the Laboratory's training database in accord with the [Training and Qualification for Staff and Non-Staff](#) subject area.

The Project Manager, or delegate, shall inform the Immediate Manager of project staff of their requirement to take project required training and assure that the training has been completed prior to project staff conducting work that requires the training. The Immediate Manager of project staff, or their delegate, shall record the need for identified project required training and

assuring training (and retraining for changes) records (for both Lab-level and project -specific training) will be maintained in accord with the [Training and Qualification for Staff and Non-Staff](#) subject area.

5.2. Quality Improvement

The project shall staff provide the level of detail in analyses, documentation, and actions necessary to comply with project quality requirements, and the customer's expectations. The project manager assures that work associated with project products, solutions, services, and processes are conducted in a manner that protects the overall quality of deliverables, integrity of the Laboratory, repeatability of the results, and customer satisfaction with the project.

When appropriate, the software development and maintenance staff will contribute to the Laboratory's Lessons Learned & Best Practices program in accord with [Lessons Learned and Best Practices](#) subject area.

The following project quality controls will be used to address key project risks and assure the repeatability of the results and integrity of the project deliverables and analyses:

- Results of analyses generated as part of this software maintenance and development and any deliverables submitted to customer shall meet the peer review requirements for [Information Release](#) as defined in SBMS.
- Documentation of calculations, analyses, tests, and software required to substantiate results and processes used to develop products/solutions (reference [Engineering Calculations, Drawings, and Specifications, Creating and Modifying](#) and [Software](#) subject areas)
- Maintaining records of documentation necessary to substantiate results and processes of software activities. [Publishing Scientific and Technical Information](#)
- At a minimum, deliverables shall meet the inspection and acceptance requirements defined in Section 5.6 of this PMP.
- Protection of intellectual property (IP) will be in accord with the SBMS [Intellectual Property--Identification, Protection, and Commercialization](#) subject area.
- All staff involved in STOMP software development and maintenance shall follow the Laboratory requirements for quality problem (e.g., deficiency or nonconformance) and PAAA reporting as defined in the [Quality Problem Reporting](#) and [Price-Anderson Amendments Act](#) subject areas.
- The SCM, or SCM delegate, shall periodically review project Assessment Tracking System (ATS) items to assure that project quality problems have been identified, reported, corrected, and closed consistent with the requirements of the [Quality Problem Reporting](#) and [Price-Anderson Amendments Act](#) subject areas.

5.2.1. Corrective Action Management

The [Assessment Tracking System \(ATS\)](#) is the process used for tracking and managing assessments, including determining Conditions and the development of actions. ATS supports the identification, control, and correction of items, services, and processes that do not meet established requirements. The [Assessment Management](#) subject area documents this corrective action management process for handling and documenting events and assessments, including those which must be tracked in ATS such as formal project reviews or audits performed by the customer or their representative; management-initiated assessments; etc.

5.3. Document and Records Management

The Software Configuration Manager (SCM), or SCM delegate, shall review, approve, issue, and revise appropriate software documentation to a sufficient detail necessary to qualify the software at the level specified in Section 5.0 of this plan. All such software documentation will be identified as records. Controlled documents are handled in accordance with the [Document Control](#) subject area.

Records pertaining to STOMP code development and maintenance will be maintained as a separate RIDS system, apart from any funding project, to preserve active records throughout the software life cycle. Copies of critical records may also be included in the RIDS of any funding project, if deemed appropriate in the pertinent project PMP.

All software documentation, including presentations, that are to be released outside PNNL, including to the project's customer, will be released in accord with the [Information Release](#) subject area.

Records are defined and managed in accordance with the [Records Management](#) subject area. The SCM will appoint a Software Custodian to maintain and control the software documentation records. The Software Custodian is responsible for creating and maintaining the software records inventory. At the end of the software life cycle, the software documentation records will be collected and transferred or archived.

5.4. Work Processes

The Software Configuration Manager, in conjunction with the project manager funding STOMP maintenance or development, or their delegate, shall identify when project-specific or task-specific plans, procedures, or permits for technical or work processes are needed that pertain to STOMP software maintenance or development. Any project-specific or task-specific plans, procedures, or permits for technical or work processes in use by a project shall be maintained as part of that project files. The requirements and guidance provided within SBMS will assist project staff in identifying and developing the necessary controls for technical or work processes to perform work consistent with technical standards, administrative controls, and hazard controls adopted by SBMS to meet regulatory or Laboratory/projects contract requirements using approved instructions, procedures, etc.

5.4.1. Software Use in Analysis

This project shall conduct work in accord with requirements for the control of software used in analyses, including software testing, as defined in the [Safety Software](#) and [Software](#) subject

areas, as applicable for the use of software of any kind by this project to conduct analyses delivered, or in support of a deliverable, to the customer. Included in this definition are data analysis tools including spreadsheets and statistical analysis software, databases, modeling and simulation tools. Excluded are software productivity tools such as word processors and spreadsheets when no automated calculations, macros, or scripts are used.

5.5. Design

The project manager for each project that adopts this software PMP into the project PMP, or their delegate, shall identify the appropriate level of quality control needed for each design, development, integration, or maintenance task within the project in accord with the [Engineering Calculations, Drawings, and Specifications, Creating and Modifying](#) and [Software](#) subject areas. The need for specific documentation and any documents generated or used by this project to support design tasks or activities shall be maintained as part of the project files.

5.5.1. Hardware

No specific hardware design is anticipated to support software maintenance and development activities.

5.5.2. Software Development and Maintenance

The primary purpose of this PMP is to control activities that will maintain STOMP as qualified safety software under the [Safety Software](#) subject area at Grading Level C. All activities related to the STOMP software life cycle will comply with this subject area that implements DOE Order 414.1c and NQA-1.

Other software, particularly Commercial Off-The-Shelf software, may be used for test interpretation and related purposes (e.g., Igor Pro, TecPlot, Microsoft Excel, etc.). For the purposes of design activities covered by this project, "software" is defined as computer programs—including computer programs embedded in firmware (reference [Software](#) subject area). Excluded is software that is an integral part of firmware or equipment, where the vendor performs all software maintenance, and the software is verified as an integral part of the system (e.g., calibration with known standard materials). Use of software for these purposes will comply with the [Software](#) subject area.

5.6. Inspection and Acceptance Testing

Determination that the STOMP software is qualified as Safety Software, Grading Level C requires review of the software documentation required in the [Safety Software](#) subject area, including the Software Requirements Specification, Software Requirements Traceability Matrix, Software Design Description, Software Test Plan, and Software Test Results. These documents shall be prepared in accordance with the [Internal Peer Review Process for Externally Communicated Scientific and Technical Information](#) section of the [Peer Review](#)

The qualification effort scheduled for the second quarter of Fiscal Year 2007 will conclude with the issuance of a Software Acceptance Report declaring which operational modes of the STOMP software are qualified as Safety Software, Grading Level C. PNNL Software Quality Engineers who are independent of the STOMP development effort will issue this report. Subsequent

qualification of additional STOMP modes will culminate with updated versions of the STOMP Software Acceptance Report to document the QA status of all STOMP software modes.

5.7. Management Assessments

No management assessments are anticipated as part of this PMP. However, management assessments will be planned in the PMP of any project that incorporates this software PMP by reference.

5.8. Independent Assessments

The project utilizes the Assessment Tracking System (ATS) to capture any inspections, project reviews, or audits conducted by the customer of the project or regulatory and oversight agencies. Audits and inspections of the project conducted by regulatory and oversight agencies shall be in accord with the [Audits and Inspections by Regulatory and Oversight Agencies](#) subject area. Any costs incurred as a result of customer inspections or tests not previously addressed shall be handled as an impact Level 1 change to the project.

At the request of the Software Configuration Manager, PNNL Software Quality Engineers who are independent of the STOMP development effort will evaluate required software documentation to verify that STOMP operational modes have qualified as Safety Software, Grading Level C under the conditions identified in the [Safety Software](#) subject area. When such independent evaluation confirms any STOMP operational modes are qualified in this way, the finding shall be documented in a Software Acceptance Report. The code version and operational modes of STOMP that are currently qualified shall be identified on the STOMP project website.

No other independent assessments are anticipated, however, if any independent assessments (internal or external) do occur they shall be captured in ATS.