Quality Assurance Project Plan
Performance Assessment Model Version 2
Clive, Utah

Prepared by

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Contents

Figures

Tables

Distribution List

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1.0 Introduction

This document describes the quality assurance project plan (QAPP) for modeling services provided for the development of a performance assessment model for the disposal of depleted uranium by Energy*Solutions* at the Clive, Utah facility. Throughout this document, the term Quality Assurance (QA) refers to a program for the systematic monitoring and evaluation of the various aspects of performance assessment model development to ensure that the models and analyses are of the type and quality of that needed and expected by the client.

2.0 Project Management and Organization

Neptune and Company (N&C) has developed this QAPP for conducting work for Energy*Solutions* under purchase order 008404. This QAPP is based on the Environmental Protection Agency (EPA) QA/G-5M Guidance for Quality Assurance Project Plans for Modeling, and our company's nineteen year history working in the environmental quality arena. A tiered approach is used that includes specific procedures developed by N&C that have been developed for modeling projects. This project-specific QAPP will work as an umbrella plan that ensures quality across all tasks.

The N&C quality program includes:

- Experienced and trained personnel who understand the QA requirements of each task.
- An experienced Project Manager.
- A corporate Quality Assurance Officer
- Task planning, tracking, and operation via internal SOPs.
- Emphasis on continuous improvement via internal reviews and customer feedback.

It is the policy of N&C to implement a quality program designed to generate products or services that meet or exceed the expectations established by our clients. This quality policy addresses all products delivered to our Energy*Solutions* client under the contract. We will ensure quality through the use of a quality program that includes program and project management, systematic planning, work and product assessment and control along with continuous improvement to ensure that data and work products are produced of acceptable quality to support the intended use.

To achieve this goal, N&C will assign appropriately qualified and trained staff and ensure that all products are carefully planned. Tasks will be conducted according to the QAPP or applicable SOP and any and all problems affecting quality will be brought to the immediate attention of the project or task manager for resolution. All products will be reviewed by another technical expert. Adequate budget and time will be planned to execute the quality system.

As indicated on Figure 1, the N&C organizational structure ensures direct reporting between the N&C Project QA Officer and the Project Manager. This structure requires that all N&C technical staff report to the N&C Project Manager who is responsible for the work.

The N&C Quality Assurance Officer has the authority and responsibility to ensure that the project-specific QAPP is implemented by N&C staff. Roles and Responsibilities for this project are detailed in Table 1. The QA aspects of the project are handled by those project members responsible for any particular part of the project. The lead modeler is responsible for QA for the GoldSim models. For probabilistic models, the lead statistician is responsible for QA of statistical routines and products that feed into the model. The responsibility for other QA tasks may be assigned to other project members at the direction of the lead modeler or lead statistician. The *model custodian* is responsible for configuration control of the model. The role of *model custodian* may be assumed by any project team member, but only one person at a time may be the custodian.

3.0 Personnel Qualifications and Training

N&C technical staff is composed of highly qualified chemists, engineers, statisticians, IT professionals, QA specialists, and biologists with advanced degrees in their fields and direct training experience. Many of the N&C staff have participated in GoldSim training courses and GoldSim User Conferences. Qualifications for the staff are shown in Table 1. Each N&C employee or contractor involved with this project will be required to read this QAPP and associated standard operating procedures (SOPs).

Figure 1: N&C Organizational Chart

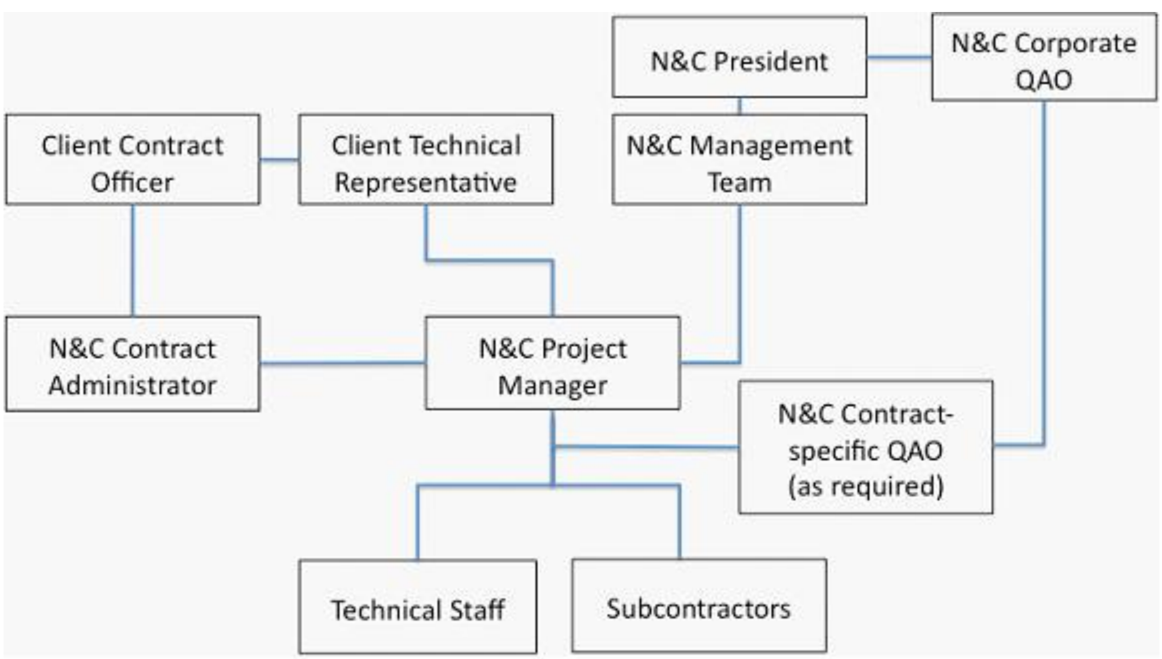

Table 1: Roles, Responsibilities, and Training

Roles	Personnel	Training
Project Manager	Paul Black	Ph.D. Statistics
QA Officer	Jim Markwiese	Ph.D. Biology
Technical Lead	John Tauxe	Ph.D. Civil Engineer, Professional Engineer (New Mexico), GoldSim Training
Modeler Biologist	Mike Balshi	Ph.D. Ecological Modeling System model training
Modeler	Katie Catlett	Ph.D. Soil Science GoldSim Training
Statistician	Mark Fitzgerald	Ph.D. Statistics
Chemist	Dave Gratson	M.S. Environmental Science and Engineering Certified Environmental Analytical Chemist GoldSim Training
Modeler	Mike Gross	Ph.D. Mechanical Engineering GoldSim Training
Project planner	Warren Houghteling	IT Specialist
Risk analyst	Robert Lee	M.S. Environmental Health
Ecologist	Greg McDermott	M.S. Entomology
Exposure and Dose Assessment Modeler	Ralph Perona	M.S. Environmental Health DABT
Statistician Modeler	Matt Pocernich	M.S. Environmental Engineering M.S. Applied Mathematics (Statistics)
Statistician	Tom Stockton	Ph.D. Environmental Modeling GoldSim Training
Hydrologist	Michael Sully	Ph.D. Soil Science GoldSim Training

4.0 Project Description

The safe storage and disposal of depleted uranium (DU) waste is essential for mitigating releases of radioactive materials and reducing exposures to humans and the environment. Currently, a radioactive waste facility located in Clive, Utah operated by Energy*Solutions* is proposed to receive and store DU waste that has been declared surplus from radiological facilities across the nation. The Clive facility has been tasked with disposing of the DU waste in an economically feasible manner that protects humans from future radiological releases.

To assess whether the proposed Clive facility location and containment technologies are suitable for protection of human health, specific performance objectives must be met for land disposal of radioactive waste set forth in Title 10 Code of Federal Regulations Part 61 (10 CFR 61) Subpart C, and promulgated by the Nuclear Regulatory Commission (NRC). In order to support the required radiological performance assessment (PA), a detailed computer model will be developed to evaluate the doses to human receptors that would result from the disposal of DU and its associated radioactive contaminants (collectively termed "DU waste"), and conversely to determine how much DU waste can be safely disposed at the Clive facility.

5.0 Critical Tasks and Schedule

Critical tasks for meeting project objectives are described in Table 2 below including the associated product and scheduled deliverable dates.

Table 2: Critical tasks for meeting project objectives, task products, and scheduled completion dates.

Task	***Product***	***Scheduled Completion Date***
Task 1. Develop a Performance Assessment Model		
SubTask 1a. Attend Kick-off Meetings	Meeting Attendance	September 2009
SubTask 1b. Model structuring based on Features, Events and Processes	Conceptual Site Model Report Preliminary GoldSim Model	February 2010
SubTask 1c. Develop a Model Representative of a Single Disposal Embankment Cell	Fully-functional probabilistic GoldSim model for a single cell	February 2011
SubTask 1d. Compare results of the initial model to the existing modeling effort	Model comparison report	January 2011
SubTask 1e. Perform Uncertainty and Sensitivity Analyses on the initial model	Uncertainty and Sensitivity Analysis report	January 2011
SubTask 1f. Demonstrate Preliminary Model and Solicit Feedback	Presentation and Training	January 2011
Task 2. Develop a Complete Model Encompassing All Candidate Disposal Cells	Complete GoldSim ES DU Model v1.0 including QA documentation, User Guide, electronic references, and supporting information	June 2011

Task	*Product*	*Scheduled Completion Date*
	Delivered on CD or DVD media	
Task 3. Training		
SubTask 3a. Train Various Audiences in Use of the Model	Training sessions	January 2011
SubTask 3b. Provide Technical Information, Training, and Interactions with the Utah Division of Radiation Control and/or other Stakeholders	Technical presentations, training sessions, question and answer sessions, and other interactions as required	November 2010 January 2011
SubTask 3c. Assist in Technical Interactions with the Nuclear Regulatory Commission.	Provide responses to comments and requests for additional information as needed	November 2010
Task 4. SQAP	SQAP revisions	Version 1 December 2009
Task 6. Project Management	Administration, reporting, planning, participation in presentations and publications	

6.0 Quality Objectives and Model Performance Criteria

Systematic planning to identify required GoldSim model components will be accomplished through the development of a conceptual site model (CSM) for the disposal of depleted uranium at the Clive facility. The CSM describes the physical, chemical, and biological characteristics of the Clive facility.

The CSM encompasses everything from the inventory of disposed wastes, the migration of radionuclides contained in the waste through the engineered and natural systems, and the exposure and radiation doses to hypothetical future humans. These site characteristics are used to define variables for the quantitative PA model that is used to provide insights and understanding of the future potential human radiation doses from the disposal of DU waste. The content of the

CSM provides the basis for selection of the significant regional and site-specific features, events and processes that need to be represented mathematically in the PA model. A report describing the CSM will be developed as part of Task 1.

As described in Section 4.0 the objective of the PA is to provide a tool for determining if specific performance objectives will be met for land disposal of radioactive waste set forth in Title 10 Code of Federal Regulations Part 61 (10 CFR 61) Subpart C, and promulgated by the NRC. The quality objective for the model is to provide results that are consistent with the site characteristics, the waste characteristics, and the CSM. If data are available, the demonstration of consistency will be supported by available site monitoring data and other field investigations. The model predictions of transport of radionuclides and the inadvertent intrusion into the disposal facility, and the sensitivity and uncertainty of the calculated results should be comprehensive representations of the existing knowledge of the site and the disposal facility design and operations.

7.0 Documentation and Records

Subversion version-control software will be used to maintain records of ownership and traceability of all project-specific files and database contents. Original data are stored in version-controlled repositories. Additions, deletions and file modifications within the repository are tracked by the version control software, which documents the file user and the date and time of modification. The version control software also offers a “compare between revisions” feature for text files that denotes line-by-line changes between previous and current versions of a file. User-entered comments are also maintained by the version control software as files are added, deleted, or modified. Version control of records is described in more detail in the Energy*Solutions* Subversion SOP in Appendix A.

Internal documentation of the GoldSim model, version change notes, change log, model versioning, model error reporting and resolution, and the project check printing procedure are described in the Energy*Solutions* GoldSim Model Development SOP in Appendix B, the Energy*Solutions* Issue Tracker SOP in Appendix C, and the Energy*Solutions* Check Print SOP in Appendix D.

8.0 Data Acceptance Criteria

The choice of data sources depends on data availability and data application in the model. The following hierarchy outlines different types of information and their application. The information becomes increasingly site-specific and parameter uncertainty is generally reduced moving down the list.

- Physical limitations on parameter ranges, used for bounding values when no other supporting information is available. *Example: Porosity must be between 0 and 1 by definition.*

- Generic information from global databases or review literature, used for bounding values and initial estimates in the absence of site-specific information. *Example: A common value for porosity of sand is 0.3.*

- Local information from regional or national sources, used to refine the above distributions, but with little or no site-specific information. *Example: Sandy deposits in the region have been reported to have porosities in the range of 0.30 to 0.37, based on drilling reports.*

- Information elicited from experts regarding site-specific phenomena that cannot be measured. *Example: The likelihood of farming occurring on the site sometime within the next 1000 years is estimated at 50% to 90%.*

- Site-specific information gathered for other purposes. *Example: Water well drillers report the thickness of the regional aquifer to be 10 to 12 meters.*

- Site-specific modeling and studies performed for site-specific purposes. *Example: The infiltration of water through the planned engineered cap is estimated by process modeling to be between 14 and 22 cm/yr.*

- Site-specific data gathered for specific purposes in the models. *Example: The density of* Pogonomyrmex *ant nests adjacent to the site is counted and found to be 243 nests per hectare.*

The determination of data adequacy is informed by a sensitivity analysis of the model, which identifies those parameters most significant to a given model result. Such parameters are candidates for improved quality. As the model development cycle proceeds, sensitive parameters are identified, and their sources are evaluated to determine the cost/benefit of reducing their uncertainty.

9.0 Data Management and Software Configuration

The acquired data, developed statistical distributions and results generated by the GoldSim model and the uncertainty and sensitivity analyses will be archived in a version-control repository as described in Section 7.0 above. Configuration management for the GoldSim model is described in the Energy*Solutions* GoldSim SOP in Appendix B.

10.0 Model Assessment and Response Actions

During model development, assessments will be conducted using a graded approach with the level of testing proportional to the importance of the model feature. Assessments will consist of:

- reviews of model theory
- reviews of model algorithms
- reviews of model parameters and data
- sensitivity analysis
- uncertainty analysis

- tests of individual model modules using alternate methods of calculation such as analytic solutions or spreadsheet calculations
- reasonableness checks

Response actions including error reporting and resolution processes are described in the Energy*Solutions* GoldSim SOP and the Energy*Solutions* Issue Tracker SOP.

11.0 Model Requirements Assessment

The purpose of these assessments is to confirm that the modeling process was able to produce a model that meets project objectives. Model results will be reviewed to ensure that results are consistent with the site characteristics, the waste characteristics, and the CSM as described in Section 6.0. Model results will be assessed to determine that the requirements of Energy*Solutions* for the use of the model have been met. Any limitations on the use of the model results will be reported to the project manager and discussed with Energy*Solutions*.