DOE/NV/25946--123

Software Quality Assurance Plan for GoldSim® Models Supporting the Area 3 and Area 5 Radioactive Waste Management Site Performance Assessment Program

Prepared by

National Security Technologies LLC

January 2007

DISCLAIMER

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

Software Quality Assurance Plan for
GoldSim® Models Supporting the Area 3 and Area 5
Radioactive Waste Management Site
Performance Assessment Program

Approved by: _____ Date: 1/19/07
John Wrapp
Environmental Management
Waste Management Program Manager

Approved by: _____ Date: 1/22/2007
Duane Snyder
Environmental Management
Environmental Safety, Health,
and Quality Assurance Manager

Approved by: _____ Date: 1-23-07
Stuart Rawlinson
Environmental Management
Waste Management Program
Task Manager for Closure and PA/CA

Approved by: _____ Date: 1/18/07
Vefa Yucel
Environmental Management
Waste Management Program
Task Lead for PA/CA

Approved by: _____ Date: 1/18/07
Greg Shott
Environmental Management
Waste Management Program
Software Custodian

CONTENTS

List of Figures

ACRONYMS and ABBREVIATIONS

CA	Composite Analysis
CD	Compact Disc
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
N&C	Neptune and Company
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NSTec	National Security Technologies, LLC
PA	Performance Assessment
QA	Quality Assurance
RWMS	Radioactive Waste Management Site
SQAP	Software Quality Assurance Plan

1.0 PURPOSE

This Software Quality Assurance Plan (SQAP) applies to the development and maintenance of GoldSim® models supporting the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) performance assessments (PAs) and composite analyses (CAs). Two PA models have been approved by the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office (NNSA/NSO) as of November 2006 for the PA maintenance work undertaken by National Security Technologies, LLC (NSTec). NNSA/NSO asked NSTec to assume the custodianship of the models for future development and maintenance. The models were initially developed by Neptune and Company (N&C).

This SQAP is developed based on NSTec's Company Directive CD-3500.009, "Software Quality Assurance"; and Requirements Document RD-3200.001, "Quality Assurance Requirements Document," both of which implement the requirements of DOE Order 414.1C, "Quality Assurance" (DOE, 2005). The GoldSim PA software has been graded Quality Grade 2.

The SQAP is also responsive to Title 10 Code of Federal Regulations 830, "Nuclear Safety Management"; the Environmental Protection Agency's (EPA's) *Guidance for Quality Assurance Project Plans for Modeling* (EPA, 2002); and DOE's *Implementation Plan for Defense Nuclear Safety Board Recommendation 2002-1* (DOE, 2003), and supplements the quality assurance (QA) procedures of NSTec referenced in the Performance Assessment/Composite Analysis Maintenance Plan. This SQAP is also compatible with the SQAP followed by N&C in the development of the current versions of the GoldSim PA models.

2.0 SCOPE

This plan is applicable to all development and revision of GoldSim models supporting PA/CAs performed by the PA/CA staff of the NSTec Environmental Management Radioactive Waste Program.

3.0 ROLES AND RESPONSIBILITIES

The following staff of the NSTec Radioactive Waste Program has roles and responsibilities in the maintenance of the GoldSim models:

- Waste Management Program Manager
- Closure and PA/CA Task Manager
- PA/CA Task Lead
- Project Team

3.1 Project Team

The project team includes subject matter experts in health physics, statistics, mathematical modeling of fate and transport processes, and GoldSim modeling. All project team members will be required to read and comply with this SQAP.

3.2 Hierarchy of Responsibilities

The Radioactive Waste Program Manager for NSTec has the ultimate responsibility for this SQAP. The task manager for Closures and PA/CA and the task lead for PA/CA have responsibility for implementing this SQAP. The team member designated by the task lead as the model custodian will be responsible for configuration control of the models. The custodian's role will be delegated in writing to another team member in his absence.

4.0 MODEL APPROVAL PROCESS

Periodically, stable model versions will be reviewed and released for routine applications such as evaluation of candidate waste streams, PA/CA modeling, preparation of annual summary reports, or sensitivity analyses. These approved releases will be referred to as baseline models. Baseline models will be submitted to NNSA/NSO for review and approval. After review, NNSA/NSO will issue an acceptability report indicating the conditions of use. The accepted baseline model will be placed in the model repository in the baseline model folder. The baseline version number, the date of the commit, and the custodian saving the baseline model will be recorded in the custody log.

5.0 MODEL DEVELOPMENT

The PA/CA models may be revised over time to accommodate changes in input data, conceptual models, user's needs, and GoldSim capabilities. Revision of the PA/CA models should occur only after consensus about the need for revision and the type of revision is reached among the PA/CA task team and NNSA/NSO. Changes to the model should be performed with the knowledge and agreement of the PA/CA task lead and NNSA/NSO. This section describes management and documentation of the revision process.

5.1 Model Custody

A single copy of the current model version of each GoldSim model will be maintained in the network model repository in the current version folder. The repository is established so that only the model custodian has write privileges. Other PA/CA project team members are limited to read-only access. The custodian will record the date, the identity of the custodian, and version number in the custody log whenever the current model version is changed.

Figure 1 summarizes the custody process. PA/CA project members assigned model development tasks shall remove the current version of the model from the repository and save a copy at a separate location with a different file name. After acceptance of the model changes, the custodian will change the current version by copying model containers and elements (when possible), recording all change documentation as described in this section, and incrementing the version number. The new version will be copied to the model archive folder.

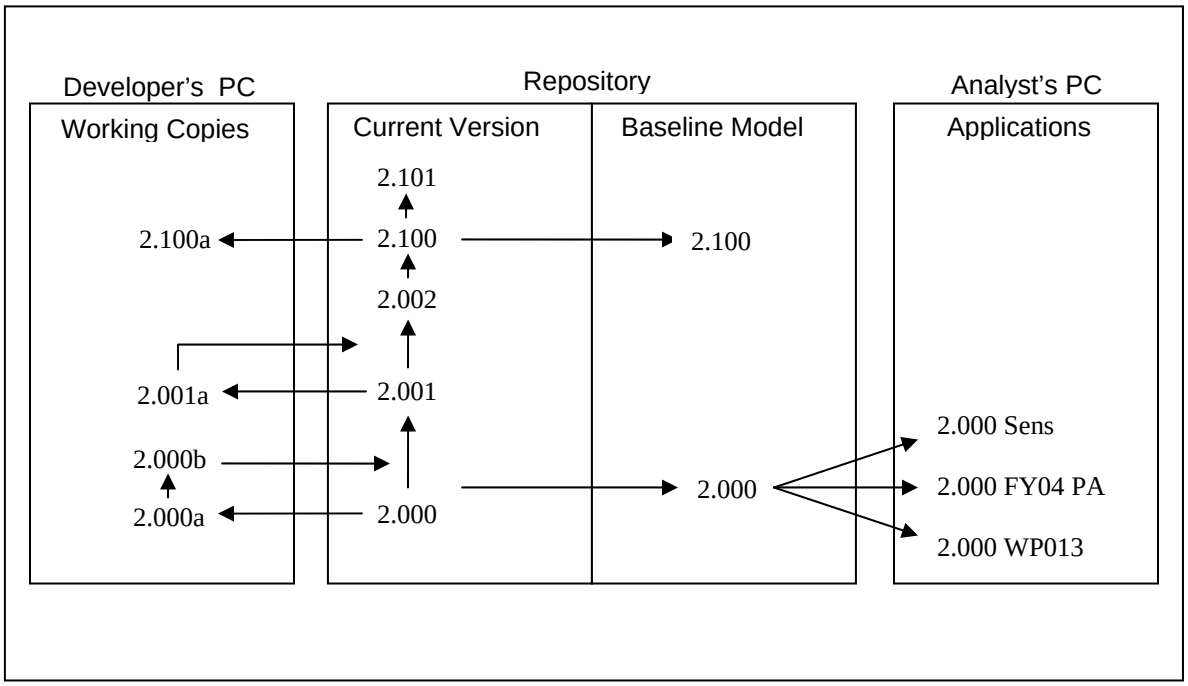

Figure 1
GoldSim Model Custody Process

5.2 Model Changes

Model changes are divided into major and minor changes. Minor changes involve changes to model graphics, note panes, and supporting documentation. Minor changes are not tracked and recorded. Major changes involve any change to a model element or container. Major changes are documented as described in Section 5.3.

5.3 Model Change Documentation

5.3.1 Model Versioning

GoldSim has an integral versioning feature that records changes occurring at the global and element levels. Reports can be generated that describe the changes occurring between any two versions. New versions will be generated when the custodian deems that sufficient changes have occurred and that a new version should be recorded. When changes to the current version have been accepted, the custodian will update the version number using the version manager (Figure 2) and save a copy of the new version in the current version and archive folder in the repository.

GoldSim version numbers are of the form X.XXX. The version number will be updated incrementally. The version number should appear as part of the file name. When major changes have occurred, the custodian may increment the version number to a higher number, indicating a major change or release of a new baseline model by discarding version numbers. For example, release of a new baseline model after version 2.020 may require that 80 version numbers are discarded to increment the version to 2.100.

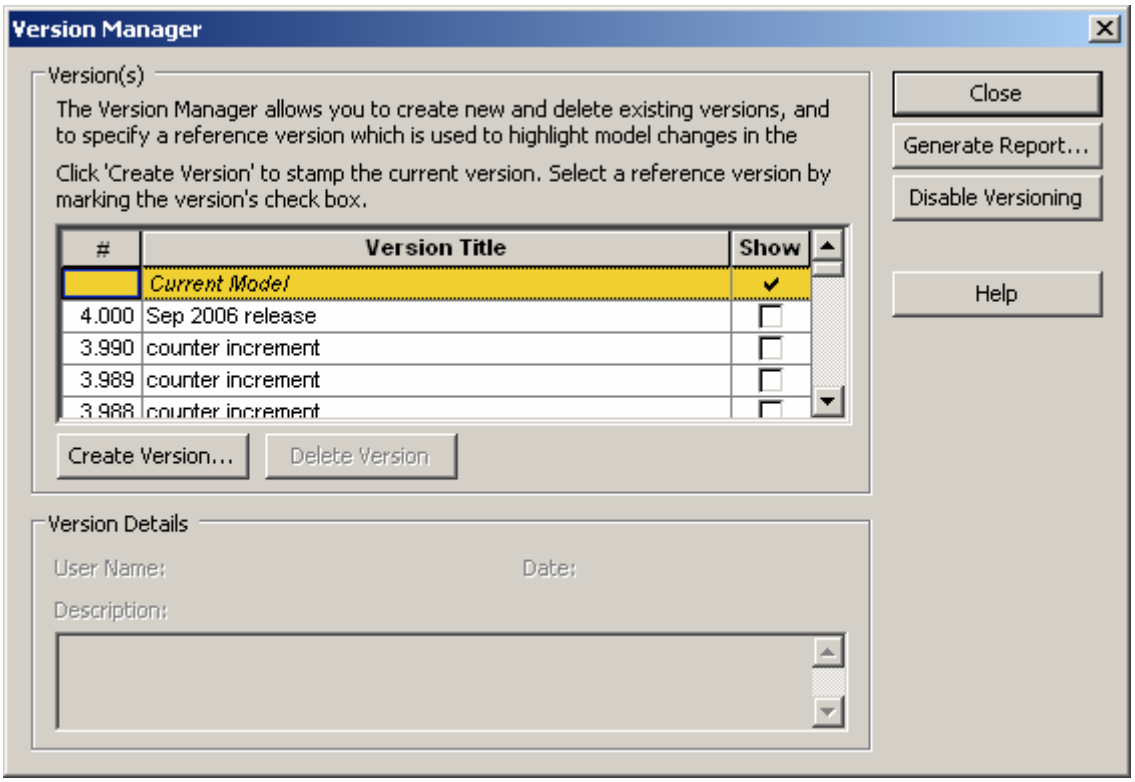

Figure 2
GoldSim Version Manager Window

5.3.2 Change Log

Each model will include a change log maintained in the note pane in an upper-level container (Figure 3). Any major changes to the model will be recorded in the change log. The information recorded will be the date, version, person making the change, and a description of the change and element modified.

5.3.3 Version Change Note

GoldSim has an integral ability to record a note describing changes to containers and elements. These notes are incorporated into model version reports. Model changes will be recorded in the version change note. Information recorded will include the date, identity of the person making the change, and a description of the change made (Figure 4).

5.3.4 Note Panes

Each element and container has an associated note pane. An element's name is underlined when a note pane contains information. Note panes are used to document the data source, assumptions, and quality assurance status of an element or container.

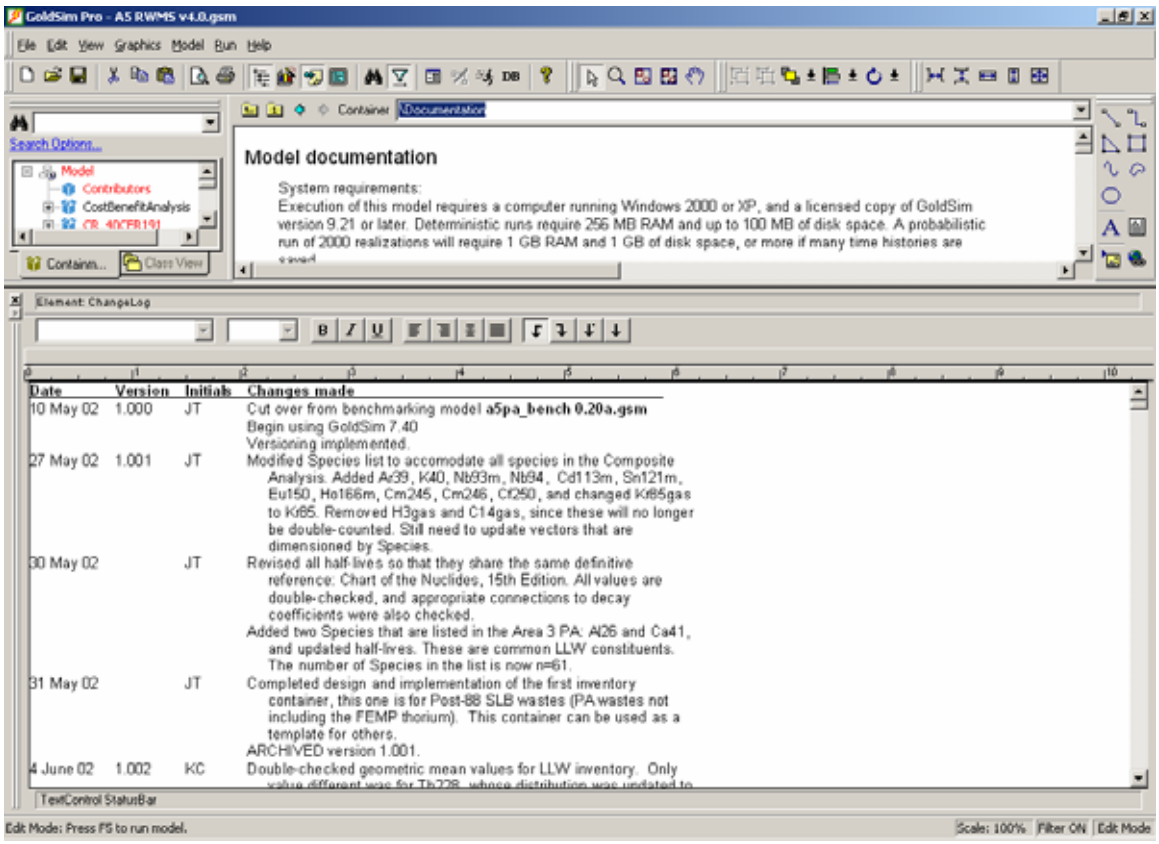

Figure 3
Change Log for the A5 RWMS PA Model

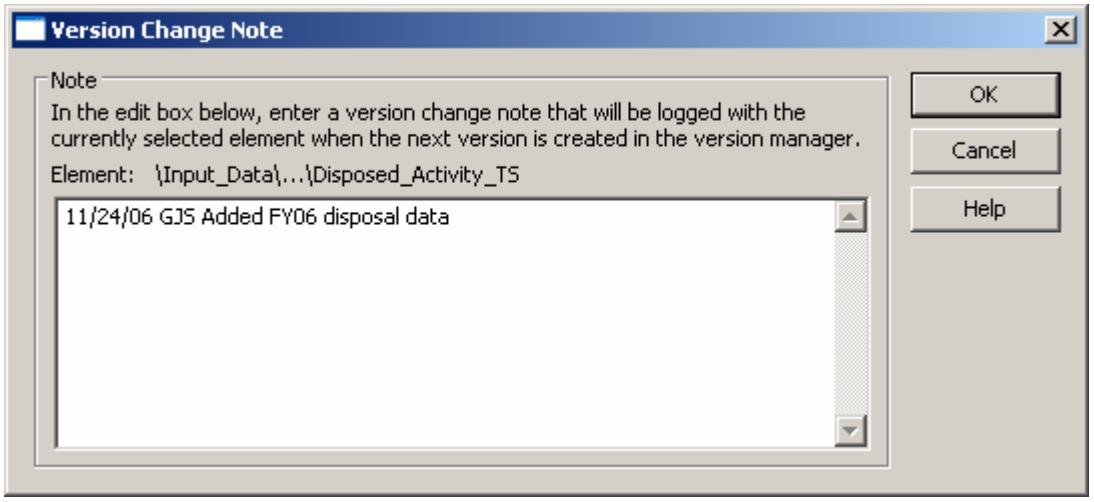

Figure 4
Version Change Note Example

5.3.5 Model Run Log

A model run log recording important model outputs for each model version is maintained for each model. The run log allows model developers and reviewers to observe the correlation between model version changes and output values. The run log also allows a QA check as changes in output that are not expected from the model changes may indicate a problem with the new version. After a new model version is generated, the model will be run and its output will be recorded in the run log.

5.3.6 What's New

Major enhancements of interest to users are noted in the "What's New" container. In the text box in this container is maintained a log of these enhancements, which is an aid to users as well as to those interested in following the history of model development.

6.0 MODEL BACKUP

The custodian for the models is responsible for preservation of the RWMS models. The current version of the model resides on an NSTec Network share drive in a protected folder. Copies of the current version, the version that is approved for maintenance applications, also reside on the custodian's computer and staff computers. (Models are also saved on CDs [compact discs], retained in custodian's office.) Backup of the network occurs daily, assuring the backup of the models.

7.0 DOCUMENTS AND RECORDS

A variety of documents provide background for the model and its input parameters. Some of these, such as white papers and articles from the literature, are directly referenced by the model through the use of hyperlink elements; and some are of ancillary importance, such as field trip photographs. The various documents of interest to QA are discussed in this section.

7.1 Documents Directly Referenced by the Model

The RWMS models make extensive use of the GoldSim hyperlink element, which has several functions. These can take the user to other parts of the model, or they can provide for the user a link to a document (a PDF [portable document format] of a paper, a spreadsheet, or a site on the World Wide Web) that is relevant to an element on the page.

7.2 Other Supporting Documents

A complete collection of all electronic files associated with the RWMS modeling projects is stored in a protected drive on the NSTec network. Each formal release of the RWMS models, in the form of a CD, includes all the documentation directly referenced in the model.

7.3 Records of Parameter Values

A list of model parameters is kept in a file external to the GoldSim model.

7.4 The Run Log

A spreadsheet called the Run Log contains a history of the values of key model results. This spreadsheet, which is maintained separate from the RWMS model, is updated with several selected model results as new model versions are generated, and is kept with the current model file.

8.0 ERROR REPORTING AND RESOLUTION

Errors in the development of the RWMS models, when discovered, are remedied. Like other changes to the model, fixing an error is documented at least in Version Change Notes and the Change Log. Resolution is to be noted in the tracking system. Each resolved error is assessed regarding its potential effects on the results. If the effect is anything more than negligible, its discovery and resolution are reported to the project participants. Similarly, if the error could have had an effect on the results of previous versions of the model, this is also reported.

9.0 MODEL REVIEW

Model changes (parameters, expressions, functional elements, model structure) that are collectively decided by the modeling team members are implemented by one of the modelers. Changes made are then checked by another team member for accuracy and completeness and approved by the PA/CA task manager. Periodically, an interim copy of the model may be provided to NNSA/NSO for a review of the model changes, in addition to the acceptability review of a newly released version. This feedback assures that all NNSA/NSO requirements and priorities are met. Any comments resulting from this review are resolved and incorporated into the model.

10.0 MODEL ASSESSMENT

The current versions of the models went through two levels of assessments to assure that models perform as intended. The initial version of the Area 5 RWMS PA model was subjected to benchmarking in which the model results were compared with the results of the performance analysis documented in the original performance assessment document for the Area 5 RWMS. The initial version of the Area 3 RWMS PA model was based on the Area 5 RWMS PA model in structure and its parameter values were derived from the original Area 3 RWMS PA document. Subsequent model versions were checked to assure that incremental changes are in line with those expected from modifications to the models. This process of checking the new model results with the results of the previous one will assure intended model performance.

10.1 Validation/Verification

The validation of the performance models can be achieved only in the sense that confidence in the model results are increased by reducing model uncertainty. This is achieved through continuous model improvements as new data and information become available and are incorporated into the models. Model results are also checked against the monitoring data to assure that the results are reasonable. The model itself contains several tools for checking the reasonableness of certain inputs and results, such as the following:

- Intermediate results are provided where they are useful for checking calculations.

- Mass balance checks demonstrate that the mass of materials (soil, water, air) and radionuclides is preserved.

- The total mass and volume of disposed wastes is calculated so that they may be compared to pit and trench volumes and disposal records, as a secondary check in the model.

Model verification refers to the assurance that software coding of many computations that the models carry out is done correctly. Initial verification of the Area 5 RWMS model included a benchmarking described above. As model changes are made, code verification is achieved by independent calculations using a calculator, spreadsheet, or a separate GoldSim model.

11.0 MODEL ACCESS CONTROL

The current versions of the models, approved by NNSA/NSO, are under strict custody control. They are the responsibility of the lead programmer, the model custodian. If another modeler is to work on the model, custody is explicitly transferred for the duration of the work, and then returned to the lead programmer. The baseline model file is in the archive folder in the repository folder. Team members must use for routine applications only the copies of the latest approved versions.

11.1 Model Distribution

Release versions of the models are delivered to the NNSA/NSO on CD or DVD [digital video disc], with supporting documentation and other model files of all test runs performed with the new version of the model.

12.0 REFERENCES

Title 10, Code of Federal Regulations 830. *Nuclear Safety Management.*

U.S. Department of Energy (DOE), 2005. DOE Order 414.1C, *Quality Assurance.* June 17, 2005.

———, 2003. Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2002-1, *Quality Assurance for Safety Software at Department of Energy Defense Nuclear Facilities.* March 2003.

U.S. Environmental Protection Agency (EPA), 2002. *Guidance for Quality Assurance Project Plans for Modeling.* EPA QA/G-5M. December 2002.

DISTRIBUTION

Jhon Carilli, LLW Federal Sub-Project Director — 4 copies
Office of Environmental Management
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office, M/S 505
P.O. Box 98518
Las Vegas, NV 89193-8518

Bruce Crowe — 1 copy
Stoller-Navarro Joint Venture/
Battelle Memorial Institute
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office, M/S 505
P.O. Box 98518
Las Vegas, NV 89193-8518

Susan Krenzien — 1 copy
Navarro Research and Engineering, Inc.
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office, M/S 505
P.O. Box 98518
Las Vegas, NV 89193-8518

Gary Pyles — 1 copy
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office, M/S 505
P.O. Box 98518
Las Vegas, NV 89193-8518

U.S. Department of Energy — 1 copy
National Nuclear Security Administration
Nevada Site Office
Public Reading Facility, M/S 400
c/o Nuclear Testing Archive
P.O. Box 98521
Las Vegas, NV 89193-8521

DISTRIBUTION (continued)

U.S. Department of Energy — 1 electronic copy
National Nuclear Security Administration
Nevada Site Office
Technical Library
P.O. Box 98518
Las Vegas, NV 89193-8518

U.S. Department of Energy — 1 electronic copy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062

National Security Technologies, LLC

T. B. Brooker, NLV022
J. A. Ciucci, NLV022
L. T. Desotell, NLV083
R. B. Hudson, NLV094
S. J. Nacht, NLV083
S. E. Rawlinson, NTS416
G. J. Shott, NLV083
D. L. Snyder, NLV022
J. K. Wrapp, NLV083
V. Yucel, NLV083