MODIFIED WORK PLAN TO SUPPORT

QUALITY ASSURANCE LEVEL ASSIGNMENTS

for

Sandia National Laboratories

NNWSI WBS ELEMENT 1.2.4.6.1.S

REPOSITORY PERFORMANCE CODE DEVELOPMENT/CERTIFICATION

Approvals (signature and date):

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List of Activities and Tasks

III A. Model/Code Development and Assessment

II B. Verification
- B.1 Preliminary Verification
- I B.2 Final Verification

C. Benchmarking and Parametric Studies

II C.1 Preliminary Benchmarking
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I C.3 Final Benchmarking

I D. Validation

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WBS 1.2.4.6.1 REPOSITORY PERFORMANCE CODE DEVELOPMENT/CERTIFICATION

1. Objectives and Issues Addressed

A. Objectives

Analysis methods, computer codes, and material models (constitutive models embodied in computer codes) will be developed, verified, benchmarked, and validated. These methods, codes, and models are being developed for application to the Exploratory Shaft Facility, the Advanced Conceptual Design, and the License Application Design activities.

B. Issues Addressed

The Issues and Information Needs addressed are based on the Yucca Mountain Issues Hierarchy dated 4/15/86.

1. This WBS element will address the following Issues and Information Needs:

Issue 1.7
- 1.7.3 Boundaries for the disturbed zone.

Issue 1.12
- 1.12.6 Predicted thermal and chemical response of the host rock, surrounding strata, and groundwater system.

Issue 4.3
- 4.3.3 Design measures for avoiding or mitigating hazards to personnel.

Issue 4.5
- 4.5.4 Potential impacts of rock characteristics on design.
- 4.5.6 Potential impacts of tectonic activity on design.
- 4.5.8 Reference preclosure repository design.

2. The information obtained in this WBS element will contribute to the resolution of the following Issues and Information Needs:

Issue 1.12
- 1.12.1 Site characterization information needed for design.
- 1.12.7 Reference postclosure underground facility designs.

Issue 1.20
- 1.20.2 Nature and rates of tectonic processes, including faulting, folding, uplift and subsidence, and seismic activity.
- 1.20.5 Potential effects of igneous and tectonic activity on rock characteristics.

Issue 2.6
2.6.3 Identification and description of safety-related items, radiation zones, and normal and accident conditions, including disruptive events.

Issue 4.10
4.10.2 Potential fault movements at the site.
4.10.3 Ground motion at the site from potential man-made or natural seismic events.

C. Regulations and Requirements Addressed

Regulations and requirements addressed by the issues referenced in this WBS are cited in the NNWSI System Requirements Document.

D. Related Project Plans

The relationship between this WBS element and other work in the project is addressed in the NNWSI Site Characterization Plan (SCP), Chapter 8 (Section 8.3.2.4). Testing related to code validation is discussed in the NNWSI Exploratory Shaft Test Plan (ESTP) and is presented in the Work Plan under WBS 1.2.6.9.2.3.S (Exploratory Shaft Geomechanical Test) and WBS 1.2.4.2.1.3.S (Laboratory Properties). The data and reference values used under this WBS will be controlled as specified in the NNWSI Systems Engineering Management Plan (SEMP) and the NNWSI Configuration Management Plan.

2. Principal Investigator

S. J. Bauer, Division 6314, Sandia National Laboratories (SNL), Albuquerque, NM.

3. Statement of Work

A. Model/Code Development and Assessment

At least three classes of material models (linear elastic/elastic-plastic; compliant joint; discrete discontinuities) are recommended for mechanical/structural calculations. Linear and nonlinear, steady and transient heat conduction codes are recommended for thermal calculations. A review of existing material models/codes will be performed in order to assess their applicability to repository performance, repository design, and site evaluation calculations. Selected material models and codes will be modified as necessary to satisfy requirements for analysis of repository performance and design.

a. Purpose: Material models necessary for the mechanical, thermal, and thermomechanical analysis of repository performance and design will be selected and/or developed to meet anticipated analytical needs for the NNWSI Project activities. Scoping or preliminary calculations will be performed using these analytical tools to

assess their adequacy and completeness prior to allowing their use in design or performance assessment analyses. Because tuff is a jointed rock, the effect of joints and fractures must be taken into account in the analysis. Thus, a compliant joint model must be developed for the mechanical and thermomechanical analysis. The remainder of the analysis capability necessary will be obtained by selecting and modifying existing material and thermal models.

b. Information Needs: 1.7.3, 1.12.6, 4.3.3, 4.5.4, 4.5.6, 4.5.8
c. Methods, Techniques, and Equipment: Finite element methods with both implicit and explicit integration. Boundary element method for linear elastic calculations.
d. Technical Procedures:
   Available Procedures - None.
   Needed Procedures - None.
e. Computer Codes:
   Available Computer Codes - SANCHO, JAC2D, JAC3D, ABACUS, COYOTE, SPECTROM-31, SAGUARO, VISCOT, and HEFF for code assessment.
   Needed Computer Codes - None.
f. Documentation of Results: SAND reports will be written as required by milestones M491 and M432.
g. Quality Assurance Level: III
h. Remarks: Compliant joint material models have been developed separately at SNL and RE/SPEC, Inc. The SNL compliant joint material model was upgraded by modifications to the joint shear response and the addition of an orthogonal joint set. Documentation of this work is being prepared. QA Level III is assigned because the analyses done under this activity are of a scoping nature.

B. Verification

Computer codes developed for engineering analysis will be verified to ensure that they correctly perform the operations specified in the numerical model. Verification will be accomplished by testing numerical computations against closed form analytic solutions. Part of the verification procedure for finite element codes will be comparison of solutions with previously fully documented boundary element codes.

B.1 Preliminary Verification

a. Purpose: In order to satisfy the requirements of SOP-03-02, the correctness of the software must be verified. Preliminary verification of materials models will be accomplished by testing numerical computations against closed form analytic solutions to help identify problems in the ability of the code to perform operation specified in the numerical model.
b. Information Needs: 1.7.3, 1.12.6, 4.3.3, 4.5.4, 4.5.6, 4.5.8

c. Methods, Techniques, and Equipment: Finite element methods with both implicit and explicit integration. Boundary element method for linear elastic calculations.
d. Technical Procedures:
Available Procedures - None.
Needed Procedures - None.
e. Computer Codes:
Available Computer Codes - SANCHO, JAC2D, JAC3D, ABACUS, COYOTE, SPECTROM-31, SAGUARO, VISCOT, and HEFF for code verification.
Needed Computer Codes - None.
f. Documentation of Results: Results will be documented in SAND reports.
g. Quality Assurance Level: II
h. Remarks: Preliminary verification of compliant joint models has been completed. QA Level II has been assigned because the task involves comparison of alternative codes.

B.2 Final Verification

a. Purpose: In order to satisfy the requirements of SOP-03-02, the correctness of the software must be verified. Final verification is intended to satisfy the requirements of SOP-03-02 and to provide the necessary documentation for software used for license application (QA Level I) analyses.
b. Information Needs: 1.7.3, 1.12.6, 4.3.3, 4.5.4, 4.5.6, 4.5.8
c. Methods, Techniques, and Equipment: Finite element methods with both implicit and explicit integration. Boundary element method for linear elastic calculations.
d. Technical Procedures:
Available Procedures - None.
Needed Procedures - None.
e. Computer Codes:
Available Computer Codes - SANCHO, JAC2D, JAC3D, ABACUS, COYOTE, SPECTROM-31, SAGUARO, VISCOT, and HEFF for code verification.
Needed Computer Codes - None.
f. Documentation of Results: Results will be documented in SAND reports.
g. Quality Assurance Level: I
h. Remarks: QA Level I is assigned because this verification must be performed prior to submittal of license application.

C. Benchmarking and Parametric Studies

Benchmarking is the comparison of the results on one item of software with the results of another item of software designed to solve a comparable problem to show that they produce similar results. Material models/codes will be benchmarked by cross-checking the numerical solutions to a series of well-defined thermal, mechanical, and thermomechanical boundary value problems. At least one benchmarking analysis will be run for each model for each problem scale to be encountered in repository design. Material properties, in-situ conditions, boundary conditions and loading conditions for

these problems will be representative of those expected of the repository. The material models will be further evaluated through parametric studies in which input parameters are systematically varied to determine the relative significance of a parameter and to ensure that the variations impart the correct sense of change in material behavior.

C.1 Preliminary Benchmarking

a. Purpose: Benchmarking is the comparison of the results on one item of software with the results of another item of software designed to solve a comparable problem to show that they produce similar results. Benchmarking will assist both the verification and validation requirements of SOP-03-02 to provide the necessary documentation for software quality assurance. Preliminary benchmarking is intended also to assist in the model development phase as a tool for identifying potential problems with the software before validation is undertaken.
b. Information Needs: 1.7.3, 1.12.6, 4.3.3, 4.5.4, 4.5.6, 4.5.8
c. Methods, Techniques, and Equipment: Finite element methods with both implicit and explicit integration. Boundary element method for linear elastic calculations.
d. Technical Procedures:
   Available Procedures - None.
   Needed Procedures - None.
e. Computer Codes:
   Available Computer Codes - SANCHO, JAC2D, JAC3D, ABACUS, COYOTE, SPECTROM-31, SAGUARO, VISCOT, and HEFF for code Benchmarking.
   Needed Computer Codes - None.
f. Documentation of Results: Results will be documented in SAND reports.
g. Quality Assurance Level: II
h. Remarks: Preliminary benchmarking is performed in parallel with code development and verification and is intended to help identify any problems with the models before conducting final benchmarking and validation studies. QA Level II is assigned because the task involves comparison of alternatives codes.

C.2 Parametric Studies

a. Purpose: Parametric studies are required to determine the sensitivity of material models to variations in input material parameters. This is an important step in evaluating the model and determining how well material data must be known for the model to accurately represent the desired material behavior. The results of these studies will be used in support of ACD and related work in the development of design specifications.
b. Information Needs: 1.7.3, 1.12.6, 4.3.3, 4.5.4, 4.5.6, 4.5.8
c. Methods, Techniques, and Equipment: Finite element methods with both implicit and explicit integration. Boundary element method for linear elastic calculations.
d. Technical Procedures:
   Available Procedures - None.
   Needed Procedures - None.

e. Computer Codes:
Available Computer Codes - SANCHO, JAC2D, JAC3D, ABACUS, COYOTE, SPECTROM-31, SAGUARO, VISCOT, and HEFF for thermomechanical studies.
Needed Computer Codes - None.

f. Documentation of Results: Results will be documented in SAND reports.

g. Quality Assurance Level: II

h. Remarks: Parametric studies are performed in parallel with code development and verification and are intended to help identify any problems with the mathematical models being used or their numerical implementation before conducting the final benchmarking and validation studies. QA Level II is assigned because the results of the parametric studies will support ACD.

C.3 Final Benchmarking

a. Purpose: Benchmarking is the comparison of the results on one item of software with the results of another item of software designed to solve a comparable problem to show that they produce similar results. Benchmarking will assist both the verification and validation requirements of SOP-03-02 to provide the necessary documentation for software quality assurance. Final benchmarking is intended to satisfy portions of the requirements for both verification and validation to produce the documentation needed to certify software for license application (QA Level I) analyses.

b. Information Needs: 1.7.3, 1.12.6, 4.3.3, 4.5.4, 4.5.6, 4.5.8

c. Methods, Techniques, and Equipment: Finite element methods with both implicit and explicit integration. Boundary element method for linear elastic calculations.

d. Technical Procedures:
Available Procedures - None.
Needed Procedures - None.

e. Computer Codes:
Available Computer Codes - SANCHO, JAC2D, JAC3D, ABACUS, COYOTE, SPECTROM-31, SAGUARO, VISCOT, and HEFF for code Benchmarking.
Needed Computer Codes - None.

f. Documentation of Results: Results will be documented in SAND reports.

g. Quality Assurance Level: I

h. Remarks: Benchmarking is a significant software quality assurance activity. Software must be accepted as QA Level I before use in LAD activities.

D. Validation

Validation is assurance that the physical model as embodied in software is a correct representation of the intended physical system or process. Validation will be accomplished by comparing the results of numerical computations with the results of field-, bench- and laboratory-scale experiments. Certain G-Tunnel (WBS 1.2.4.2.1.2.S),

Exploratory Shaft (WBS 1.2.6.9.2.3.S), and Laboratory (WBS 1.2.4.2.1.3.S) experiments were developed for this purpose. The purpose of these physical models is to test the physics embodied in the material models. Analog material tests may be appropriate for this purpose. Validation analysis may also be conducted by comparing calculated results to experimental results available in the open literature. In general, the validation process will be conducted using the following series of steps: (1) Experiment design analysis is performed in order to develop the experiment concept into a design which will address the phenomena of interest, (2) site specific data and material properties are collected for model calculations, (3) a pretest analysis is performed, (4) the experiment is conducted, (5) the pretest analysis is reevaluated in light of the actual experimental procedure, and (6) a post-test comparison of experiment and analysis is conducted by a peer review panel.

a. Purpose: Model validation is required by SOP-03-02 as one step in the process of software certification for use in QA Level I analyses. Validation calculations also provide assistance in documenting the applicability of the model to the geologic repository, including any extrapolations, restrictions and the effects of unusual or extreme conditions peculiar to the repository.
b. Information Needs: 1.7.3, 1.12.6, 4.3.3, 4.5.4, 4.5.6, 4.5.8
c. Methods, Techniques, and Equipment: Finite element methods with both implicit and explicit integration. Boundary element method for linear elastic calculations.
d. Technical Procedures:
   Available Procedures - None.
   Needed Procedures - None.
e. Computer Codes:
   Available Computer Codes - SANCHO, JAC2D, JAC3D, ABACUS, COYOTE, SPECTROM-31, SAGUARO, VISCOT, and HEFF for code validation.
   Needed Computer Codes - None.
f. Documentation of Results: Results will be documented in SAND reports.
g. Quality Assurance Level: I
h. Remarks: Model validation is required by SOP-03-02 as one step in the process of software certification for use in QA Level I analyses such as those in support of LAD. A preliminary validation study for the compliant joint models, in which thermally fractured granite was used as a physical model, has been completed and the results published.

4. Data and Materials Needed

Activity/Task A. Model/Code Development and Assessment

Date Needed - Joint properties for development and evaluation of material models.
Source of Data - Reference Information Base (RIB) or Tuff Data Base.
Quality of Data - As defined in the Reference Information Base.

Materials Needed - N/A.
Source of Materials - N/A.
Quality of Materials - N/A.

Task B.1 Preliminary Verification and Task B.2 Final Verification

Data Needed - Analytic solutions to specific boundary value problems. Some solutions may require modification in order to capture the effect of a coupled thermal and mechanical response.
Source of Data - Peer reviewed open literature or the RIB.
Quality of Data - As defined in the Reference Information Base.

Materials Needed - N/A.
Source of Materials - N/A.
Quality of Materials - N/A.

Task C.1. Preliminary Benchmarking

Data Needed - Tuff material properties data for numerical models.
Source of Data - Reference Information Base or peer reviewed open literature.
Quality of Data - As defined in the Reference Information Base.

Materials Needed - N/A.
Source of Materials - N/A.
Quality of Materials - N/A.

Task C.2. Parametric Studies

Data Needed - Tuff material properties data for numerical models.
Source of Data - Reference Information Base.
Quality of Data - As defined in Reference Information Base.

Materials Needed - N/A.
Source of Materials - N/A.
Quality of Materials - N/A.

Task C.3. Final Benchmarking

Data Needed - Tuff material properties data for numerical models.
Source of Data - Reference Information Base or other sources as appropriate.

Quality of Data - Because benchmarking is a comparison of software using the same model and input data, the quality level of the data is not a significant factor as long as it falls within the range of reasonably expected values. However, every effort will be made to use data of highest quality available.

Materials Needed - N/A.
Source of Materials - N/A.
Quality of Materials - N/A.

Activity/Task D. Validation

Data Needed - Site specific and experiment specific material properties data for numerical models. Experimental data collected during validation experiments (WBS 1.2.6.9.2.3.S and WBS 1.2.4.2.1.2.S).
Source of Data - Tuff Data Base.
Quality of Data - The quality of the data will vary depending on the particular experiment to be modeled.

Materials Needed - N/A.
Source of Materials - N/A.
Quality of Materials - N/A.

5. Non-Standard Methods or Techniques

Activity/Task A. Model/Code Development and Assessment

The compliant joint model is a relatively new material model that has not been rigorously tested. A substantial effort will be required to complete the tasks supporting it; however, the model's conceptual promise warrants such an effort.

6. Location of Work Performance

Sandia National Laboratories, Albuquerque, NM.

Contractors: RE/SPEC, Inc., Albuquerque, NM
Technadyne, Albuquerque, NM

7. Quality Assurance Requirements

Quality Assurance Level Assignments

The following Quality Assurance Levels have been assigned to the tasks described in this WBS.

Quality Assurance Level I: Task B.2, C.3 and D.
Quality Assurance Level II: Tasks B.1, C.1 and C.2.
Quality Assurance Level III: Activity/Task A.

8. Application of Results

The necessary documentation of material models/computer codes for mechanical, thermal, and thermomechanical analyses provides direct support for Design Analysis (2.4.6.2), Field Test (2.4.2.1.2), Rock-Mass Analysis (2.4.2.1.1), and indirect support for Subsurface Excavations (2.4.3.4) and Sealing (2.4.2.3).

9. Schedule

Starting Date: 1984
Expected Ending Date: 1991

10. Past and Expected Achievements

A. Past Achievements

Compliant joint material models, developed separately at SNL and RE/SPEC, have completed some very basic verification steps.

A validation study for the compliant joint models, in which thermally fractured granite is the physical model, has been completed and the results have been published.

The compliant joint model was upgraded by modifications to the joint shear response and the addition of an orthogonal joint. Documentation of this work will be published shortly.

B. Expected Achievements

FY86

Perform finite element calculations to support material model qualification: preliminary verification of compliant joint models.

Evaluate modeling efforts in support of field experiments and field measurements in order to assess the status of the codes/material models.

FY87

Perform and report on pre- and post-test compliant joint model validation analysis in support of benchscale large block laboratory test.

Begin compliant joint model benchmarking and parametric studies calculations.

Perform compliant joint model validation analysis of G-Tunnel Mining Experiment.

FY88

Continue and report on compliant joint model benchmarking and parametric studies calculations.

Report on compliant joint model validation analysis of G-Tunnel Mining Experiment.

Evaluation modeling efforts in support of field experiments and field measurements in order to assess the status of the codes/material models.

FY89

Perform and report on validation analyses for plate-loading experiments.

Perform and report on validation analyses for small-scale heater experiments.

Perform pre-test validation analysis of Sequential Drift Mining Evaluations.

Perform pre-test validation analysis of Canister-Scale Heater Experiment.

Perform post-test validation analysis of Sequential Drift Mining Evaluations.

Perform post-test validation analysis of Canister-Scale Heater Experiment.

FY91

Complete report on post-test validation analysis of Sequential Drift Mining Evaluations.

Complete report on post-test validation analysis of Yucca Mountain Heated Block Experiment.

Complete report on post-test validation analysis of Canister-Scale Heater Experiment.

Complete summary report on thermal, mechanical, and thermomechanical material models/codes for license application design.

11. Milestones and Deliverables

Milestone Number	Description and Criteria	Completion Date
Level 2		
M491	Summary Report on Geomechanical Analyses as Reference to the SCP This deliverable is a SAND report submitted for policy review on the status of thermomechanical models/analyses for use as an SCP reference.	06/30/86 (estimated)
M432	Report on Rock-Mass Constitutive Model The deliverable will be a SAND report which recommends and details a constitutive model with which rock-mass response to thermal, mechanical, and thermomechanical loads can be calculated.	10/30/86
P089	Report on compliant joint model validation analysis of G-tunnel mining experiment.	09/30/88
P081	Report on validation analyses for plate-loading experiments.	09/28/90
P082	Summary report on compliant joint model benchmarking activities.	07/31/90
P083	Report PM validation analysis for small-scale heater experiments.	09/28/90
P090	Report on post-test validation analysis of sequential drift mining evaluations.	04/30/91
P091	Report on post-test validation analysis of Yucca Mountain heated-block experiment.	06/28/91
P092	Report on post-test validation analysis of canister-scale heater experiment.	06/28/91
P094	Summary report on thermal-mechanical and thermo-mechanical material models/codes for license application design.	09/30/91

12. Costs

Costs are in thousands of expenditure-year dollars.

FY86

SNL Labor Costs: $119 Other Costs: $210

FY87

SNL Labor Costs: $211 Other Costs: $463

FY88

SNL Labor Costs: $282 Other Costs: $677

FY89

SNL Labor Costs: $359 Other Costs: $804

13. Performance Measurement

Level of Effort.

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APPROVALS (Signature and Date)

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Activity: A. Model/Code Development and Assessment

Task Description	QA Level	QA Criteria	Level Justification
A. Same as Activity	III	* 1-7, 15-18	Compliant joint model will be developed and other material models will be assessed to determine applicability to repository performance and design. This task is assigned QA Level III as Steps 1 through 11 of the logic diagram do not apply.

* QA LEVEL III CRITERIA FOR SNL USE ONLY

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET
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Activity: A. Model/Code Development and Assessment

Task: A. Same as Activity PI S. J. Bauer

QA Criterion	Applies	Does Not Apply	Comments
1. QA Organization	X		
2. QA Program	X		
3. Design & Scientific Investigation Control	X		Scientific Investigation Requirements apply.
4. Procurement Document Control	X		
5. Instructions Procedures & Drawings	X		
6. Document Control	X		
7. Control of Purchased Material, Equipment, and Services	X		Control of contractor services applies.
8. ID and Control of Materials, Parts, Components and Samples		X	No manufacturing or samples involved.
9. Control of Processes		X	No special processes.
10. Inspection		X	No inspection or surveillance involved.
11. Test and Experiment/ Research Control		X	No tests/experiments.
12. Control of Measuring and Test Equipment		X	No manufacturing or tests involved.
13. Handling, Shipping, and Storage		X	No instruments, hardware or samples involved.
14. Inspection, Test, and Operating Status		X	No inspection or tests involved.
15. Control of Nonconformances	X		
16. Corrective Action	X		
17. QA Records	X		
18. QA Audits	X		

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Activity: B. Verification

Task Description	QA Level	QA Criteria	Level Justification
B.1. Preliminary Verification	II	1-7, 15-18	QA Level II is assigned because preliminary verification involves comparison of alternative codes. (Step 10)
B.2. Final Verification	I	1-7, 15-18	QA Level I is assigned because final verification is performed for codes used in support of license application analyses. (Step 6)

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Activity: B. Verification

Task: B.1. Preliminary Verification PI S. J. Bauer

QA Criterion	Applies	Does Not Apply	Comments
1. QA Organization	X		
2. QA Program	X		
3. Design & Scientific Investigation Control	X		Scientific Investigation Requirements apply.
4. Procurement Document Control	X		
5. Instructions Procedures & Drawings	X		
6. Document Control	X		
7. Control of Purchased Material, Equipment, and Services	X		Control of contractor services applies.
8. ID and Control of Materials, Parts, Components and Samples		X	No manufacturing or samples involved.
9. Control of Processes		X	No special processes.
10. Inspection		X	No inspection or surveillance involved.
11. Test and Experiment/ Research Control		X	No tests/experiments.
12. Control of Measuring and Test Equipment		X	No manufacturing or tests involved.
13. Handling, Shipping, and Storage		X	No instruments, hardware or samples involved.
14. Inspection, Test, and Operating Status		X	No inspection or tests involved.
15. Control of Nonconformances	X		
16. Corrective Action	X		
17. QA Records	X		
18. QA Audits	X		

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Activity: B. Verification

Task: B.2. Final Verification

PI S. J. Bauer

QA Criterion	Applies	Does Not Apply	Comments
1. QA Organization	X		
2. QA Program	X		
3. Design & Scientific Investigation Control	X		Scientific Investigation Requirements apply.
4. Procurement Document Control	X		
5. Instructions Procedures & Drawings	X		
6. Document Control	X		
7. Control of Purchased Material, Equipment, and Services	X		Control of contractor services applies.
8. ID and Control of Materials, Parts, Components and Samples		X	No manufacturihg or samples involved.
9. Control of Processes		X	No special processes.
10. Inspection		X	No inspection or surveillance involved.
11. Test and Experiment/ Research Control		X	No tests/experiments.
12. Control of Measuring and Test Equipment		X	No manufacturing or tests involved.
13. Handling, Shipping, and Storage		X	No instruments, hardware or samples involved.
14. Inspection, Test, and Operating Status		X	No inspection or tests involved.
15. Control of Nonconformances	X		
16. Corrective Action	X		
17. QA Records	X		
18. QA Audits	X		

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Activity: C. Benchmarking and Parametric Studies

Task Description	QA Level	QA Criteria	Level Justification
C.1 Preliminary Benchmarking	II	1-7, 15-18	QA Level II is assigned because preliminary benchmarking involves comparison of alternative codes. (Step 10)
C.2 Parametric Studies	II	1-7, 15-18	QA Level II is assigned because the parameteric studies will be used to support ACD. (Step 10)
C.3 Final Benchmarking	I	1-7, 15-18	QA Level I is assigned because final benchmarking is performed to certify code for support of licnese application analyses. (Step 6)

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Activity: C. Benchmarking and Parametric Studies

Task: C.1. Preliminary Benchmarking PI S. J. Bauer

QA Criterion	Applies	Does Not Apply	Comments
1. QA Organization	X		
2. QA Program	X		
3. Design & Scientific Investigation Control	X		Scientific Investigation Requirements apply.
4. Procurement Document Control	X		
5. Instructions Procedures & Drawings	X		
6. Document Control	X		
7. Control of Purchased Material, Equipment, and Services	X		Control of contractor services applies.
8. ID and Control of Materials, Parts, Components and Samples		X	No manufacturing or samples involved.
9. Control of Processes		X	No special processes.
10. Inspection		X	No inspection or surveillance involved.
11. Test and Experiment/ Research Control		X	No tests/experiments.
12. Control of Measuring and Test Equipment		X	No manufacturing or tests involved.
13. Handling, Shipping, and Storage		X	No instruments, hardware or samples involved.
14. Inspection, Test, and Operating Status		X	No inspection or tests involved.
15. Control of Nonconformances	X		
16. Corrective Action	X		
17. QA Records	X		
18. QA Audits	X		

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET

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QALAS No. 102 Rev. B

Activity: C. Benchmarking and Parametric Studies

Task: C.2. Parametric Studies PI S. J. Bauer

QA Criterion	Applies	Does Not Apply	Comments
1. QA Organization	X		
2. QA Program	X		
3. Design & Scientific Investigation Control	X		Scientific Investigation Requirements apply.
4. Procurement Document Control	X		
5. Instructions Procedures & Drawings	X		
6. Document Control	X		
7. Control of Purchased Material, Equipment, and Services	X		Control of contractor services applies.
8. ID and Control of Materials, Parts, Components and Samples		X	No manufacturing or samples involved.
9. Control of Processes		X	No special processes.
10. Inspection		X	No inspection or surveillance involved.
11. Test and Experiment/ Research Control		X	No tests/experiments.
12. Control of Measuring and Test Equipment		X	No manufacturing or tests involved.
13. Handling, Shipping, and Storage		X	No instruments, hardware or samples involved.
14. Inspection, Test, and Operating Status		X	No inspection or tests involved.
15. Control of Nonconformances	X		
16. Corrective Action	X		
17. QA Records	X		
18. QA Audits	X		

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET

WP No. 12461-86 Rev. B

QALAS No. 102 Rev. B

Activity: C. Benchmarking and Parametric Studies

Task: C.3. Final Benchmarking

PI S. J. Bauer

QA Criterion	Applies	Does Not Apply	Comments
1. QA Organization	X		
2. QA Program	X		
3. Design & Scientific Investigation Control	X		Scientific Investigation Requirements apply.
4. Procurement Document Control	X		
5. Instructions Procedures & Drawings	X		
6. Document Control	X		
7. Control of Purchased Material, Equipment, and Services	X		Control of contractor services applies.
8. ID and Control of Materials, Parts, Components and Samples		X	No manufacturing or samples involved.
9. Control of Processes		X	No special processes.
10. Inspection		X	No inspection or surveillance involved.
11. Test and Experiment/ Research Control		X	No tests/experiments.
12. Control of Measuring and Test Equipment		X	No manufacturing or tests involved.
13. Handling, Shipping, and Storage		X	No instruments, hardware or samples involved.
14. Inspection, Test, and Operating Status		X	No inspection or tests involved.
15. Control of Nonconformances	X		
16. Corrective Action	X		
17. QA Records	X		
18. QA Audits	X		

NNWSI QUALITY ASSURANCE LEVEL ASSIGNMENT SNL-QA-001

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APPROVALS (Signature and Date)

PI Stephen J Bauer 7/25/86
PQA Connie Choate 7/25/86
Supervisor J. R. Tillerson 7/25/86
TPO Thomas Hunter 7/25/86
WMPO (PQM) James Blaylock 7/29/86
WMPO (Tech) R. L. Spence 7/29/86

Activity: D. Validation

Task Description	QA Level	QA Criteria	Level Justification
D. Same as Activity	I	1-7, 15-18	QA Level I is assigned validation is performed to certify code for support of license application analyses. (Step 6)

QUALITY LEVEL ASSIGNMENT CRITERIA SHEET

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Activity: D. Validation

Task: D. Same as Activity

PI S. J. Bauer

QA Criterion	Applies	Does Not Apply	Comments
1. QA Organization	X		
2. QA Program	X		
3. Design & Scientific Investigation Control	X		Scientific Investigation Requirements apply.
4. Procurement Document Control	X		
5. Instructions Procedures & Drawings	X		
6. Document Control	X		
7. Control of Purchased Material, Equipment, and Services	X		Control of contractor services applies.
8. ID and Control of Materials, Parts, Components and Samples		X	No manufacturing or samples involved.
9. Control of Processes		X	No special processes.
10. Inspection		X	No inspection or surveillance involved.
11. Test and Experiment/ Research Control		X	No tests/experiments.
12. Control of Measuring and Test Equipment		X	No manufacturing or tests involved.
13. Handling, Shipping, and Storage		X	No instruments, hardware or samples involved.
14. Inspection, Test, and Operating Status		X	No inspection or tests involved.
15. Control of Nonconformances	X		
16. Corrective Action	X		
17. QA Records	X		
18. QA Audits	X		