# CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

## QUALITY ASSURANCE AUDIT PLAN

FOR CNWRA (INTERNAL) AUDIT 94-1

OF

THE CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

SAN ANTONIO, TEXAS

MAY 3-6, 1994

Prepared by _____ Date 2/16/94

Approved by _____ Date 2/17/94

## 1. AUDIT SCOPE

This audit will evaluate the CNWRA QA program to determine whether it meets the applicable requirements of 10 CFR Part 50, Appendix B. This will be done by verifying implementation and effectiveness of the CNWRA QA program. Corrective Action Requests initiated during Audit 93-1 (May 4-7, 1993) and since will be reviewed to determine the effectiveness of corrective actions. This will be a performance-based audit, evaluating programmatic requirements in light of their application to technical activities.

## 2. ACTIVITIES TO BE AUDITED

| 10 CFR Part 50, Appendix B Criteria | | Corresponding CQAM Chapter |
|---|---|---|
| I | Organization | 1 |
| II | QA Program | 2 |
| N/A | Scientific Investigation & Analysis Control | 3 |
| IV | Procurement Document Control | 7 |
| V | Instructions, Drawings, & Procedures | 5 |
| VI | Document Control | 6 |
| VII | Control of Purchased Material | 7 |
| VIII | Identification and Control of Items | 8 |
| IX | Control of Processes | 9 |
| XII | Control of Measuring and Test Equipment | 12 |
| XIII | Handling, Storage, and Shipping | 13 |
| XV | Nonconformance Control | 15 |
| XVI | Corrective Action | 16 |
| XVII | Records Control | 17 |
| XVIII | Audits | 18 |

Design-related activities are not performed by the CNWRA, so 10 CFR 50, Appendix B Criteria III, X, XI, and XIV are not applicable. All CNWRA CQAM chapters are affected.

| Technical Activities | Project Number |
|---|---|
| WSE&I Subtask 2.1 - CDS Development | 20-5702-221 |
| WSE&I Subtask 5.2, 5.3 - RPD Version 3.0/OITS Development | 20-5702-252, -253 |
| External QA | 20-5702-331 |
| PA Subtask 2.3 - Iterative Performance Assessment | 20-5702-723 |
| GS Subtask 2.5 - Investigate Issues in Geology/Geophysics | 20-5702-425 |
| Thermohydrology Task 5 - Matrix and Fracture Properties | 20-5704-025 |
| IWPE Task 1 - Corrosion | 20-5704-041 |
| Field Volcanism Task 2 - Mafic Eruption Dynamics | 20-5704-142 |
| Field Volcanism Task 3 - Release of Volatiles & Hydrothermal Alter. | 20-5704-143 |
| Tectonic Analysis (All Tasks) | 20-5704-161, -164, -166 |

The audits of the technical activities shall evaluate (i) the technical qualifications of scientific investigation personnel, (ii) their understanding of procedural requirements as they pertain to technical activities, (iii) the adequacy of technical procedures, and (iv) the development of technical reports, supporting documentation, and other work products.

## 3. ORGANIZATIONS TO BE AUDITED

The CNWRA and SwRI organizations directly supporting the CNWRA (calibration labs, testing facilities, etc.) shall be included in this audit.

## 4. AUDIT TEAM

The audit team will be staffed with NQA-1 qualified lead auditors and auditors from the SwRI Quality Assurance Department. Technical Specialists shall be independent of the activities to be audited, technically qualified, and shall be trained in auditing techniques. The audit team will consist of:

T. Trbovich Audit Team Leader

The balance of the audit team (auditors and technical specialists) shall be identified at a later date.

## 5. APPLICABLE DOCUMENTS

CNWRA QA Manual (CQAM)
CNWRA QA Procedures (QAPs)
Applicable CNWRA Technical Operating Procedures (TOPs)
Applicable portions of the CNWRA Operations Plans for the Division of High-Level Waste Management
Applicable CNWRA Research Project Plans
Title 10, Code of Federal Regulations, Part 50, Appendix B
ASME/ANSI NQA-1

## 6. TENTATIVE SCHEDULE FOR AUDIT ACTIVITIES

| | |
|---|---|
| May 3, 1994, 8:30 a.m. | Audit Team/Observer Meeting |
| May 3, 1994, 9:00 a.m. | Audit Entrance Meeting |
| May 3, 1994, 9:30 a.m. - 4:00 p.m. | Auditing |
| May 4-5, 1994, 8:30 a.m. - 4:00 p.m. | Auditing |
| May 6, 1994, 8:30 a.m. - 1:30 p.m. | Auditing |
| May 6, 1994, 2:00 p.m. | Audit Exit Meeting |

Daily caucuses with the Audit Team and observers will be held at 4:00 p.m. Daily meetings with the Audit Team Leader and CNWRA management will be held at 8:00 a.m.

## 7. AUDIT PROCEDURE AND CHECKLIST

The audit shall be conducted in accordance with QAP-011. Checklists for programmatic requirements and technical activities shall be prepared and available for NRC review prior to the beginning of the audit.

## 8. OBSERVERS

This audit may be observed by QA and technical representatives from the U.S. Nuclear Regulatory Commission.

# CNWRA AUDIT 94-01 ASSIGNMENTS

| TASK | TECHNICAL SPECIALIST | AUDITOR | TECHNICAL CONTACT |
|---|---|---|---|
| WSE&I 2.1 | R. Folck | R. Weber | R. Brient |
| WSE&I 5.2, 5.3 | R. Folck | R. Weber | A. DeWispelare |
| EQA | D. Dunavant | D. Dunavant | B. Mabrito |
| PA 2.3 | R. Mason | T. Trbovich | R. Manteufel |
| GS 2.5 | W. Thomann | R. Weber | S. Young |
| Thermo Hydro Res. 5 | C. Freitas | D. Dunavant | R. Green |
| IWPE Res. 1 | R. Page | D. Dunavant | N. Sridhar |
| Field Volcanism Res. 2&3 | D. Smith | R. Weber | C. Connor, B. Hill |
| Tectonics Res. (all) | W. Thomann | T. Trbovich | D. Ferrill |

## TENTATIVE SCHEDULE

| Tuesday (4/26/94) | Wednesday (4/27/94) | Thursday (4/28/94) | Friday (4/29/94) |
|---|---|---|---|
| 9:00 a.m.<br><br>Pre Audit Conference<br>(Conference A237) | 8:30 - 11:30 a. m.<br><br>Field Volcanism Tasks 2 & 3<br>(Conference A242) | 8:30 - 11:30 a.m.<br><br>WSE&I Subtasks 2.1<br>(Conference A132)<br>IWPE Task 1<br>(Bldg. 57- Lab.) | 8:30 - 11:30 a.m.<br><br>Follow-up |
| 9:30 - 11:30 a.m.<br><br>GS Subtask 2.5<br>(Conference A242) | 9:30 - 11:30 a.m.<br><br>EQA<br>(Conference A132) | | 2:00 p.m.<br><br>Audit Exit<br>Conference<br>(Conference A237) |
| 12:30 - 4:00 p.m.<br><br>GS Subtask 2.5<br>(Conference A242)<br>PA Subtask 2.3<br>(Conference A239) | 12:30 - 4:00 p.m.<br><br>Field Volcanism Tasks 2 & 3<br>(Conference A242)<br>Tectonics<br>(Conference A239)<br>Thermohydrology Task 5<br>(Bldg. 57 - Lab.) | 12:30 - 4:00 p.m.<br><br>Tectonics<br>(Conference A239)<br>WSE&I Subtasks 5.2 & 5.3<br>(Conference A132)<br>IWPE Task 1<br>(Bldg. 57 - Lab.) | |
| 4:00 p.m.<br><br>Team Caucus<br>(Conference A237) | 4:00 p.m.<br><br>Team Caucus<br>(Conference A237) | 4:00 p.m.<br><br>Team Caucus<br>(Conference A237) | |

Revision No. 1 - 4/28/94

# CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

## INTERNAL AUDIT CHECKLIST
**Audit No. 94-1**

### TABLE OF CONTENTS

# CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

## INTERNAL AUDIT CHECKLIST
**Audit No. 94-1**

TABLE OF CONTENTS 

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 1
## Organization

Item 1 (Doc)
Paras. 1.6.1(1) and 1.6.2

Are SwRI staff who perform activities affecting quality and outside consultants or subcontractors who perform data interpretation, and analyses qualified in accordance with the Center CQAM, Section 2.6?

Item 2 (Doc)
Para. 1.6.1 (3)

Do Center QA staff perform reviews of internal, vendor, and nuclear power client audit reports to confirm that NQAPM controls are adequate and effective?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 2
## Quality Assurance Program

Item 3 (Doc, Int)
Para. 2.5.1
QAP-013, Rev. 1, Chg. 0
Para. 3.2.3

Does the Center Director of QA schedule internal audits and surveillances to evaluate the effectiveness of the QA program?

Item 4 (Doc)
Para. 2.6.3
QAP-005, Rev. 0
Paras. 3.1 and 3.2

Have new personnel since June 1, 1993, been trained both in QA program implementation and applicable Operating Procedures in their assigned areas? Is objective evidence of personnel qualification maintained?

Item 5 (Doc)
QAP-007, Rev. 0
Para. 3.2 and 3.5

Have Professional Personnel Qualification forms been completed for new personnel at the Center since June 1, 1993? Are qualification records reviewed annually and documented on QAP-11 forms?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 3
## Scientific Investigation and Analysis Control

Item 6 (Doc)
Para. 3.4(2)

Have the results of literature searches been documented and have they received technical reviews?

Item 7 (Doc, Int)
Para. 3.9(2)
QAP-014, Rev. 0, Chg. 0
Para. 3.3

Have calculations been checked or otherwise verified by sample overchecking or alternate verification? Are records available documenting these checks and verifications?

Item 8 (Doc)
Para. 3.10(2)
QAP-002, Rev. 4, Chg. 1
Para. 5.2.1

Are peer reviews planned and fully documented?

**PROGRAMMATIC ASSESSMENT AREA**
**CQAM, Revision 2, Change 6**
**Section 3**
**Scientific Investigation and Analysis Control (continued)**

Item 9 (Doc)
Para. 3.10(2)
QAP-002, Rev. 4, Chg. 1
Para. 5.1.1

Are technical reviews planned and fully documented, verifying the technical correctness of the work?

Note: NUREG 1298, "Qualification of Existing Data for High-Level Nuclear Waste Repositories", also applies to the following items.

Item 10
QAP-015, Rev. 0, Chg. 0
Para. 5.1

Have data been subjected to criteria to determine if it is subject to qualification under Section 5.2 of this procedure?

Item 11
QAP-015, Rev. 0, Chg. 0
Para. 5.

During document review, have documents using data (data that is candidate for evaluation under QAP-015) been verified to be compliant with QAP-015?

**PROGRAMMATIC ASSESSMENT AREA**
**CQAM, Revision 2, Change 6**
**Section 3**
**Scientific Investigation and Analysis Control (continued)**

Item 12
QAP-015, Rev. 0, Chg. 0
Para. 5.2

How are existing data that have been determined to be subject to qualification, evaluated or otherwise qualified prior to use? Has the method used been documented?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 5
## Instructions, Procedures and Drawings

Item 14 (Doc)
Para. 5.3(2)

Do instructions, procedures, and drawings include appropriate quantitative or qualitative acceptance criteria when applicable?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 6
## Document Control

Item 15 (Doc)
Para. 6.2.(5), 6.4.6
QAP-008, Rev. 1, Chg. 1
Para. 3.3.4

Is a Master Document List maintained for the distribution and control of documents?

Item 16 (Doc, Int)
Para. 6.5.2
QAP-008, Rev. 1, Chg. 1
Para. 3.4.4

Are controlled documents transmitted with the appropriate instructions to review and a return of acknowledgement? Are acknowledgements returned?

Item 17 (Doc, Lab)
Para. 6.5.1.(6)
QAP-008, Rev. 1, Chg. 1
Para. 3.4.6

Are uncontrolled documents clearly indicated as such?

**PROGRAMMATIC ASSESSMENT AREA**
**CQAM, Revision 2, Change 6**
**Section 7**
**Procurement Control**

Item 18 (Doc)
Paras. 7.3.2 and 7.6
QAP-016, Rev. 0, Chg. 0
Paras. 6.1, 6.2

Are items verified upon receipt by review of supplier's documentation or as meeting specific technical requirements when purchased from nonqualified suppliers?

Item 19 (Doc)
Para. 7.5
QAP-016, Rev. 0, Chg. 0
Paras. 6.1, 6.2

How are purchases made from non-qualified suppliers accepted? Are other purchases made from suppliers evaluated in accordance with 7.5.2 and periodically evaluated?

Item 20 (Doc, Int, Lab)
QAP-006, Revision 1
Para. 3.1.2

Do items remain in the custody of $Q_{rs}$ until required acceptance activities are complete?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 8
## Identification and Control of Items, Software, and Samples

Item 21 (Lab)
Para. 8.3.1
TOP-012, Rev. 1, Chg. 0
Paras. 4.1 and 4.2

Are purchased items, materials, and equipment identified upon receipt and acceptance with tags, markings, and are records traceable to the item including item description, unique receiving number, and when applicable, lot, heat, or batch number?

Item 22 (Lab)
Para. 8.3.4
TOP-012, Rev. 1, Chg. 0
Paras. 4.6.2 and 4.6.3

Is the shelf life of limited shelf-life items clearly identified?

Item 23
Para. 8.4.1(1)
TOP-012, Rev. 1, Chg. 0
Paras. 4.1.2, 4.1.3, 4.5

Are measures taken to assure identification of materials and samples over time when the originals have been subdivided?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 9
## Control of Processes

Item 24
Paras. 9.3, 9.5, 9.6

For those processes listed in Paragraph 9.3, if performed, have the processes been

a) defined by procedure of instructions?

b) performed by qualified personnel?

c) documented to show objective evidence of proper accomplishment?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 12
## Control of Measuring and Test Equipment

Item 25 (Doc)
Para. 12.4.1

Is equipment maintained in a calibrated condition subject to a periodic recall system?

Item 26 (Lab)
Para. 12.4.1(4)

Is calibrated material and test equipment controlled so that affixed to the item itself, the case, or other logical place, is a label or tag that exhibits the identifying number of the item, the date of last calibration, the date the next calibration is due, and the identity of the calibrating personnel or organization?

Item 27 (Doc)
Para. 12.8, 2.6.1

Are personnel who perform calibration services qualified in accordance with CQAM Section 2? Have key calibration personnel been trained in accordance with 2.6.1?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 13
## Handling, Storage, and Shipping

Item 28 (Doc, Lab)
Para. 13.5(1)
TOP-012, Rev. 1, Chg. 0
Para. 4.4.2

Do controls for samples include, as appropriate, methods to maintain the as-sampled conditions?

Item 29 (Doc, Lab)
Para. 13.5(2)

Do procedures include requirements for marking and labeling materials, samples, and equipment to adequately identify, maintain, and preserve the item?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 15
## Nonconformance Control

Item 30 (Doc, Int)
Para. 15.1

Are nonconforming items identified, segregated, reported, and dispositioned in accordance with controls outlined in Section 15?

Item 31 (Doc)
QAP-009
Para. 3.3(3)

Have nonconformances been processed since June 1, 1993? For nonconformances processed during this past year, have dispositions, distribution, and closeouts been accomplished in the required manner?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 16
## Corrective Action

Item 32 (Doc, Int)
Para. 16.1

Are conditions adverse to quality identified and reported and are appropriate corrective actions provided by Element Managers? Is verification and closeout effective?

Item 33 (Doc)
Followup from Center Audit 93-1
CARs 93-1, 93-2, 93-3

Has corrective action been properly implemented and verified for the Corrective Action Requests initiated as a result of Center Audit 93-1?

**PROGRAMMATIC ASSESSMENT AREA**
**CQAM, Revision 2, Change 6**
**Section 17**
**Records Control**

Item 34 (Doc, Int)
QAP-012
Para. 3.5.1

Are records received from Element Managers validated by signature on the QA Records Processing Form?

## PROGRAMMATIC ASSESSMENT AREA
## CQAM, Revision 2, Change 6
## Section 18
## Audits

Item 35 (Doc)
Para. 18.5

Are documented audit plans prepared for each audit identifying the audit scope, organizations to be notified, applicable documents, schedule, and audit procedure or checklist?

Item 36 (Doc)
QAP-004, Rev. 0
Para. 3.2

Review any Center surveillances conducted since June 1, 1993. Have surveillance plans been included in the QA portion of Project Plans?

Item 37
QAP-013, Rev. 1, Chg. 0
Para 3.1

Is initial quality planning being accomplished through the preparation and use of a Quality Requirements Application Matrix?

## TECHNICAL ASSESSMENT AREA
## Waste Systems Engineering and Integration Element (WSE&I)
## Subtask 2.1. Compliance Determination Strategy (CDS) Development

Item 38

What steps were taken to ensure that the text of the CDSs match that contained in the draft text of the License Application Review Plan (LARP) and the Regulatory Program Database (RPD)? Reference: Major Milestone 5702-221-420

Item 39

What is the methodology being used in the performance of the consistency/integration review of CDSs for FY '94?

Item 40

How are the integration and consolidation of key technical uncertainties (KTU) included in the review of CDSs noted above?

Item 41

Review the background and expertise of those participating in the completion of this subtask.

## TECHNICAL ASSESSMENT AREA
## Waste Systems Engineering and Integration Element (WSE&I)
## Subtask 5.2. Regulatory Program Database (RPD) and Open Item Tracking System (OITS) Development

Item 42

What features are being added to the RPD to make it more capable and responsive for all users?

Item 43

Does the user guide for RPD V1.0 include descriptions of the Systematic Regulatory Analysis (SRA) (~~SRS~~) process and the database design, guidelines for basic system use, and discussion of additional capabilities?

Item 44

What is the design of the RPD/OITS database? How does the database design guarantee the validity of the output?

Item 45

Was the level of RPD/OITS testing exhaustive? Did testing address system requirements? Reference: OITS System Requirements Definition, 5702-032-125.

Item 46

Review the background and expertise of those participating in the completion of this subtask.

## TECHNICAL ASSESSMENT AREA
## Waste Systems Engineering and Integration Element (WSE&I)
## Subtask 5.3. RPD and OITS Maintenance and Operation

Item 47

What is the status of the following activities:

1. Operator training;

2. Loading of data into the RPD and OITS;

3. System maintenance;

4. System optimization; and

5. Password control?

Item 48

What design documentation is available to aide in the maintenance of the RPD and OITS data bases?

Item 49

Implement the RPD and OITS using applicable user's guides to evaluate the user interface design. In general, determine if the RPD/OITS: are consistent; provide meaningful feedback; permit easy reversal of most actions; reduce the amount of information that must be memorized; forgive mistakes; produce meaningful error messages; and provide help facilities.

## TECHNICAL ASSESSMENT AREA
## Waste Systems Engineering and Integration Element (WSE&I)
## Subtask 5.3. RPD and OITS Maintenance and Operation (continued)

Item 50

Review the background and expertise of those participating in the completion of this subtask.

## TECHNICAL ASSESSMENT AREA
### External Quality Assurance

Item 51
Ref. EQA 3.3.1.1

Please provide a listing of all QA observations audits, observations of DOE surveillances, or participation in HLW-related meetings, and DOE QA plans reviewed by CNWRA staff in FY94-95.

Item 52
Ref EQA 3.3.1.1

Is CNWRA QA on schedule to perform 10 QA observation audits of the DOE HLW Repository Program in FY94-95?

Item 53
Ref. EQA 3.3.1.1

Is CNWRA QA on schedule to observe 10 DOE surveillances or participate in HLW-related meetings in FY94-95?

Item 54
Ref. EQA 3.3.1.2

Has the CNWRA QA been directed to review and report on DOE QA plans? If so, did the CNWRA review and report as requested?

## TECHNICAL ASSESSMENT AREA
### External Quality Assurance (continued)

Item 55
Ref. EQA 3.3.1.2

Did the CNWRA staff use the appropriate NRC written requirements for the review of DOE QA plans and ensure all pertinent points were fully addressed?

Item 56
Ref. EQA 3.3.1.2

How have lessons learned from the EQA element been integrated into the Internal QA Task of COPS?

Item 57
Ref. EQA 3.3.1.2

Have all EQA activities been reported either by formal report, by identification of completed milestone, or by letter providing the date, place, persons, and scope?

Item 58
Ref. EQA Subtask 3.3.1.2

Do the CNWRA staff performing EQA functions possess the expertise and knowledge of nuclear QA as evidenced by experience in auditing, surveillance, nuclear power programs, and specific training regarding observation audits, independent audits, or HLW-type surveillance?

## TECHNICAL ASSESSMENT AREA
### External Quality Assurance (continued)

Item 59
Ref. EQA 3.3.1.1

What method is used to plan for observation audits or observation of surveillance to ensure appropriate NRC requirements are satisfied?

Item 60
Ref. EQA 3.3.1.1

What methods of reporting results is used for the observation audits or observation of surveillances to provide the required results to the NRC?

## TECHNICAL ASSESSMENT AREA
### Iterative Performance Assessment
### Subtask 2.3. Performance Assessment Research

Item 61

*Who are the principal investigators of this subtask?

Item 62

What qualifications and experiences do they have that specifically relate to this subtask?

Item 63

What are the objectives of the technical work?

Item 64

What has been accomplished to date for this subtask?

Item 65

What are the technical approaches? Have they considered other approaches?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
### Iterative Performance Assessment
### Subtask 2.3. Performance Assessment Research (continued)

Item 66

Describe the status of the Total Performance Assessment system code. What calculational methods are being used? How and how often are calculations verified? How is uncertainty being measured and risk being evaluated?

Item 67

How will the system code methodology be improved as the program progresses? Is program efficiency a goal in this effort?

Item 68

What is the Performance Assessment strategic plan? What are its key elements?

Item 69

What was learned from IPA Phase 2? What areas of TPA require improvement based on these results? How is this being implemented?

Item 70

What are the plans for software configuration management for the various modules in being used in this subtask?

## TECHNICAL ASSESSMENT AREA
### Iterative Performance Assessment
### Subtask 2.3. Performance Assessment Research (continued)

Item 71

Why is biosphere and dose modelling not being addressed in the technical review?

Item 72

How will sensitivity analysis be used to estimate the range of infiltration rates? Who does this?

Item 73

What does the VTOUGH code do? Has it been developed?

Item 74

What computer codes and types of documentation have been developed?

## TECHNICAL ASSESSMENT AREA
### Iterative Performance Assessment
### Subtask 2.3. Performance Assessment Research (continued)

Item 75

What are the major assumptions and limitations of these codes? How are the mathematical assumptions and implications checked for appropriateness? for validation?

Item 76

What codes remain to be developed? What will be the evaluation criteria?

Item 77

Much of the work centers on computer code development. What are the sources of expertise in this area?

Item 78

How will modifications to the code be made?

Item 79

What untested codes and/or methodologies were used in the code development?

## TECHNICAL ASSESSMENT AREA
### Iterative Performance Assessment
### Subtask 2.3. Performance Assessment Research (continued)

Item 80

How are the SNL technical reports to be reviewed? What expertise is available to perform this review work?

Item 81

How will DOE and NRC Performance Assessment activities be matched? What criteria will be used?

## TECHNICAL ASSESSMENT AREA
### Subtask 2.5. Investigation of Issues Related to Geology/Geophysics

Item 82

* Who is the Principal Investigator (PI) and who are the other personnel working on this task?

Item 83

What are the qualifications of the PI and other personnel?

Item 84

Does the PI maintain a scientific notebook and keep other records to document project activities and results?

Item 85

What are the investigators' experiences in evaluating magmatic modeling?

Item 86

What model or models will be used that will be based on conservative or realistic assumptions? How will you judge between conservative and nonconservative models?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
### Subtask 2.5. Investigation of Issues Related to Geology/Geophysics (continued)

Item 87

How will estimates of probability and consequences of repository disruption due to igneous activity be determined if accepted methods of calculating impact of data uncertainty are not available?

Item 88

What are the assumptions about the state of the magmatic system that will impact probability estimates?

Item 89

What is the status of tectonic modeling and data analysis?

## TECHNICAL ASSESSMENT AREA
### Subtask 2.5. Investigation of Issues Related to Geology/Geophysics (continued)

Item 90

The following three types of modeling are described in Subtask 2.5:

1. Geometric Modeling - update existing model as structural data becomes available from new drill holes and the exploratory drift.

2. Computer Simulation - concentration on effort to better understand faulting processes.

3. Visualization Modeling - develop 3-D pictorial models that permit better conceptual understanding of the geology of the repository and surrounding area.

* What is the status of the three models described above and the status of overall seismic analysis? What is the SEISM code and how will it be used in seismic analysis?

Item 91

* Are the milestones/deliverables for FY94 and FY95 on schedule? Are the investigations of Subtask 2.5 on schedule? How far along are the milestones/deliverables for the latter part of FY94?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
### Thermohydrology
### Task 5. Matrix and Fracture Properties

Item 92

Who is involved in this effort, what are their responsible areas, and what makes them suitable for performing their subtask?

Item 93

What are the important properties of matrix/fractures that are required for predictive numerical simulation of multi-phase flow and/or understanding the phenomena in general?

Item 94

Describe what experimental techniques are to be evaluated for the characterization of matrix/fracture properties?

Item 95

How does one determine the experimental uncertainty associated with these methods?

Item 96

What are the levels of uncertainty that are necessary for validating a numerical simulation's results?

## TECHNICAL ASSESSMENT AREA
### Thermohydrology
### Task 5. Matrix and Fracture Properties (continued)

Item 97

Why are moisture characteristic curves important?

Item 98

What test media are to be used in the measurement of moisture curves?

Item 99

What select media are to be used in the measurement of moisture curves?

Item 100

What methods are to be used to measure moisture curves in these media and what is the experimental uncertainty?

Item 101

If ideal and select media are used to measure moisture curves which are then used to valid models, how does one then extrapolate this to Yucca Mountain where the matrix/fracture properties are not quantified?

## TECHNICAL ASSESSMENT AREA
### Thermohydrology
### Task 5. Matrix and Fracture Properties (continued)

Item 102

Do these ideal and select media have nonlinear responses similar to that at Yucca Mountain?

Item 103

Describe the Submersible Pressure Outflow Cell. What data does it provide and what is its uncertainty?

Item 104

Will a single fracture be studied or multiple, intersecting fractures?

Item 105

What will be the consolidated medium used in the fracture experiments?

## TECHNICAL ASSESSMENT AREA
### Thermohydrology
### Task 5. Matrix and Fracture Properties (continued)

Item 106

How will these "yet unidentified measurement" technologies be identified?

Item 107

What is the schedule for this effort? And, what is the budget?

Item 108

Describe the experimental procedure for the measurement of moisture curves?

Item 109

How will an experimental procedure be developed for these "yet unidentified" measurement techniques?

Item 110

Describe the experimental procedure for the Submersible pressure outflow cell?

## TECHNICAL ASSESSMENT AREA
### Thermohydrology
### Task 5. Matrix and Fracture Properties (continued)

Item 111

Will numerical simulations be performed in this Task? If so, what simulations?

## TECHNICAL ASSESSMENT AREA
## IWPE
### Task 1. Corrosion

Item 112

Who is performing the simulated crevice experiments and what are their qualifications?

Item 113

What written documentation of the experimental procedures for the simulated crevice experiments is available?

Item 114

How are the results of the SEM and stereoscopic examinations of specimen surfaces documented and archived?

Item 115

Who performed the EDS analysis? Were calibration checks made to insure accuracy? Was pertinent operating information recorded with the results?

Item 116

How many crevice simulation tests were repeated to determine repeatability of results?

## TECHNICAL ASSESSMENT AREA
## IWPE
### Task 1. Corrosion (continued)

Item 117

Why is the $E_{rp}$ for pitting measured on a polished specimen considered a conservative lower bound for predicting localized corrosion?

Item 118

Does the dependence of $E_{rp}$ on pit depth vary with surface chromium depletion?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 2. Mafic Eruption Dynamics

Item 119

* Who are the principal investigators?

Item 120

What are their qualifications?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
## Field Volcanism
## Task 2. Mafic Eruption Dynamics
## Literature Review

Item 121

What is the status of the literature review, i.e. completed, in progress, months remaining?

Item 122

What search methods did you use to find relevant materials?

Item 123

Were all materials of a refereed nature?

Item 124

What types of documents were included? Scientific, peer-reviewed journal publications? Government documents? Monographs?

Item 125

Are copies of reviewed references archived and catalogued? Who curates the collection?

## TECHNICAL ASSESSMENT AREA
## Field Volcanism
## Task 2. Mafic Eruption Dynamics
## Literature Review (continued)

Item 126

Who were the CNWRA reviewers of literature? What are their qualifications?

Item 127

Were references reviewed in a standardized manner?

Item 128

Are the reviewer's names and notes collected with the references?

Item 129

Are data or interpretations reported in refereed publications and in non-refereed publications distinguished in their significance?

Item 130

Regarding the Tolbachik eruptions, are any data/interpretations NOT written in English? If so, who did the translations and what are their qualifications in translating scientific literature?

## TECHNICAL ASSESSMENT AREA
## Field Volcanism
## Task 2. Mafic Eruption Dynamics
## Geologic Field Work

Item 131

What is the status of field work, i.e., completed, in progress, months remaining?

Item 132

What areas were studied? Cima? Pisgah-Amboy? Fortification Hills? Black Hills, California? Cerro Negro? Paricutin/Jorullo?

Item 133

Have any new geologic maps been produced? If so, of what scale are they and how detailed, i.e. have individual eruptive/flow units been mapped?

Item 134

Where and how did you sample volcanic gases? How did you avoid atmospheric contamination?

Item 135

Have the samples been chemically analyzed? By what methods?

**TECHNICAL ASSESSMENT AREA**
**Field Volcanism**
**Task 2. Mafic Eruption Dynamics**
**Geologic Field Work (continued)**

Item 136

How can you distinguish between magmatic and meteoric water in gas samples?

Item 137

Were the original objectives modified during the course of field investigations? If so, how?

Item 138

How many tephra/lava samples were collected and analyzed per volcano? Per eruptive unit? Can I see you sampling list?

Item 139

What level of stratigraphic control did you have in your sampling program?

## TECHNICAL ASSESSMENT AREA
## Field Volcanism
## Task 2. Mafic Eruption Dynamics
## Geochemical, Petrographic, and Mineralogical Analyses on Field Samples

Item 140

Have you conducted major, minor and trace element analyses of solid field samples? Eruptive phases?

Item 141

How were bulk-rock samples prepared for geochemical analysis? Who did the sample preparation? Did they keep a log of their work?

Item 142

What types of geochemical analytical methods were employed? Where were the analyses conducted?

Item 143

How was analytical precision and accuracy assessed in the above analyses? What are the estimated errors associated with the major element analyses? Trace elements?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 2. Mafic Eruption Dynamics
### Geochemical, Petrographic, and Mineralogical Analyses on Field Samples (continued)

Item 144

Were petrographic analyses conducted on all samples analyzed for bulk-rock chemistry? If not, what percentage was not petrographically analyzed?

Item 145

Who did the petrographic analyses and what are their qualifications?

Item 146

How were vesicle-size distributions determined?

Item 147

Have you obtained ion and electron microprobe analyses of phenocryst glass inclusions and matrix glasses? If so, where were they obtained? Who performed the analyses and what are they analyst's qualifications?

Item 148

How were samples selected for ion probe or EMP analysis?

## TECHNICAL ASSESSMENT AREA
## Field Volcanism
## Task 2. Mafic Eruption Dynamics
## Geochemical, Petrographic, and Mineralogical Analyses on Field Samples (continued)

Item 149

What volatiles were analyzed? How were the precision/accuracy of the analyses assessed and what are the estimated errors?

Item 150

What kinds of variations were found in matrix glass versus phenocryst glass inclusions with regards to their magmatic volatile contents?

Item 151

Have any whole-rock dates (K-Ar) been obtained? If so, how many? Who did the work and where?

Item 152

Did you consider other age dating methods besides whole-rock K-Ar? If so, what are they? Did you employ them?

## TECHNICAL ASSESSMENT AREA
## Field Volcanism
## Task 2. Mafic Eruption Dynamics
## Miscellaneous

Item 153

Has Dr. Yuri Doubik visited your office to exchange data and coordinate future field work at Tolbachik? If so, what were the outcomes of those visits?

Item 154

Do Task 2 activities include the studies on the probability of volcanic disruption of the YMR (estimated via Poisson models, e.g.)?

Item 155

Were these studies a significant component of your efforts this year? If so, how much time was spent on such studies?

Item 156

Do Task 2 activities include vent distribution studies (i.e., the Springerville volcanic field study by Connor et al., 1992)?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 2. Mafic Eruption Dynamics
### Miscellaneous (continued)

Item 157

Were such studies a significant component of your efforts this year? If so, how much time was spend on such studies?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 3. Release of Volatiles and Hydrothermic Alteration

Item 158

* Who are the Principal Investigators? What are their qualifications?

Item 159

Has mapping of cinder cones been initiated? completed? If so, which inactive cones have been mapped? Which active cones? At what scale?

Item 160

Were alteration zones and thermal features mapped? If so, what field characteristics were used to identify them?

Item 161

Were electrical mapping methods utilized? If so, what kinds of data were collected? Who collected the data?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 3. Release of Volatiles and Hydrothermic Alteration (continued)

Item 162

What is the extent of hydrothermal upwelling/diffuse degassing as revealed by these methods? What types of data did you evaluate in drawing any interpretations?

**At inactive volcanic sites:**

Item 163

Have you been able to assess the extent of hydrothermal alteration? If so, how did you do so?

Item 164

Were temperature measurements made at active fumaroles? If so, how were the measurements made?

Item 165

Were gas samples collected at active fumaroles? If so, how did you sample the gases? How did you avoid atmospheric contamination?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 3. Release of Volatiles and Hydrothermic Alteration (continued)

Item 166

Were any gaseous components at a given site monitored as a function time? If so, which ones? Over what time period?

Item 167

How can you distinguish between magmatic and meteoric water in gas samples?

Item 168

If isotopes were used as a means of identifying magmatic vs. meteoric components, which isotopes were analyzed for? Where were the analyses conducted? Are the data useful in distinguishing magmatic vs. meteoric components?

Item 169

Was all analytical work done in one laboratory? If not, how did you evaluate inter-laboratory results?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 3. Release of Volatiles and Hydrothermic Alteration (continued)

Item 170

Has geochemical soil sampling been accomplished? If so, where? Which at active volcanoes? at which inactive volcanoes?

Item 171

What elements were analyzed for? What analytical methods were employed? What is the estimated precision and accuracy associated with the employed methods?

Item 172

In evaluating hydrothermal alteration at active/inactive cinder cones, were XRD/EMP methods employed? What type(s) of data were useful in the evaluation and interpretation of hydrothermal upwelling/diffuse degassing?

Item 173

What structural control can you place on the location and/or extent of alteration zones at active/inactive cinder cones?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 3. Release of Volatiles and Hydrothermic Alteration (continued)

Item 174

Are any vertical changes in alteration observed within a given cinder cone? If so, how did you document such changes?

Item 175

How did you determine the geochemistry of circulating fluids/gases at active cinder cones? at inactive cinder cones? I.e., what analytical methods were employed? Where were the analyses conducted?

Item 176

How was analytical precision and accuracy assessed in the above analyses? What are the estimated errors?

Item 177

What is the status of field sampling of 1943-52 Paricutin deposits?

## TECHNICAL ASSESSMENT AREA
### Field Volcanism
### Task 3. Release of Volatiles and Hydrothermic Alteration (continued)

Item 178

How have these samples been used to characterize current degassing at this cinder cone?

Item 179

What type(s) of data are used to evaluate degassing at this cinder cone?

Item 180

What is the status of planning for field investigations at the Tolbachik cinder cones?

## TECHNICAL ASSESSMENT AREA
Tectonics
All Tasks

Item 181

Who is the Principal Investigator (PI) and who are the other investigators on this project? What are the qualifications of each investigator?

Item 182

What is the role of each investigator? How is the work of each investigator assigned and documented?

## TECHNICAL ASSESSMENT AREA
### Tectonics
### Task 1. Review of Literature and Other Sources of Data on Late and Quaternary Tectonism in the Central Basin and Range Region

Item 183

How was the literature search conducted and what is the status of this search? How are the references stored and catalogued?

Item 184

How are the data and results of refereed versus non-refereed publications distinguished? What records are kept by persons reviewing and assessing references?

Item 185

What is the process for selecting references for review? How do you decide what is and what is not an important reference?

Item 186

What are other potential sources of data, published and unpublished, in addition to the Geodynamics Database of the National Space Science Data Center and the Yucca Mountain project subcontractor data file?

## TECHNICAL ASSESSMENT AREA
### Tectonics
### Task 1. Review of Literature and Other Sources of Data on Late and Quaternary Tectonism in the Central Basin and Range Region (continued)

Item 187

How are the types of information such as data on age determinations, fault displacements, ground rupture and associated earthquake seismicity, etc., recorded, stored, and retrieved?

Item 188

How will data acquired from technical meetings and field trips be kept as records and documented with respect to their accuracy, validity, and quality?

## TECHNICAL ASSESSMENT AREA
### Tectonics
### Task 1. Review of Literature and Other Sources of Data on Late and Quaternary Tectonism in the Central Basin and Range Region (continued)

Item 189

* When did Task 1 start and what is its completion date?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
## Tectonics
## Task 2. Compilation of Tectonic Data for the Central Basin and Range Region into a Computerized GIS

Item 190

* What is the status of data compilation in tectonism, faulting, and seismicity for GIS?

Item 191

What process was used for literature search and selection?

Item 192

How will the information of Task 2 be shared am .g other researchers within the CNWRA?

Item 193

How will you evaluate adequacy of database as a source of information for the NRC and DOE?

Item 194

Who does the map digitizing and how much time is spent digitizing map data versus compiling other kinds of geological and geophysical data into GIS?

* This question can be answered before the audit in order to free up time for other questions

## TECHNICAL ASSESSMENT AREA
## Tectonics
### Task 2. Compilation of Tectonic Data for the Central Basin and Range Region into a Computerized GIS (continued)

Item 195

Explain how GIS data will be used to serve Task 6 modeling. How are geologic and other maps incorporated into GIS?

Item 196

Why is GIS technology useful in the compilation of tectonic data for Task 2?

Item 197

* When did Task 2 start and when is its completion date?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
## Tectonics
## Task 3. Critical Review of Compiled Tectonic Data for the Central Basin and Range Region

Item 198

How will the uncertainties related to data collection, analytical methods, and assumptions in existing models be assessed regarding review of the database in Task 2?

Item 199

How will such data be recorded and catalogued?

Item 200

What, if any, conceptual models have been developed with respect to tectonic processes and events in the Central Basin and Range region?

Item 201

What do you mean by "adequacy" of data review in deterministic and probabilistic seismic hazard assessment and for scenario development and assessment?

## TECHNICAL ASSESSMENT AREA
## Tectonics
## Task 3. Critical Review of Compiled Tectonic Data for the Central Basin and Range Region (continued)

Item 202

How will you determine data requirements for modeling and analysis of coupled faulting, seismic and groundwater interactions, and for supporting integration of models of repository rock mechanical response with models of the geological structure and hydrogeology of Yucca Mountain?

Item 203

How do existing conceptual models for seismic-tectonic processes and events compare tot he proposed model(s) of Task 3?

Item 204

What is the status of the acquisition and assessment of the seven specific technical issues related to tectonics that the NMSS staff have identified? How are each of these technical issues addressed by the CNWRA investigators? How will these data be incorporated in this and subsequent tasks?

## TECHNICAL ASSESSMENT AREA
## Tectonics
### Task 4. Field Investigations to Assess Estimates of Late Neogene and Quaternary Strain and to Support Development and Assessment of Alternative Models of Late Neogene through Quaternary, and Contemporary Tectonic Development of the Central Basin and Range Region

Item 205

* Who are the geologists, geophysicists, and other personnel involved in the field investigations of Task 4?

Item 206

What kind of geologic mapping (i.e., structure, stratigraphic, volcanic, or all geology, photogeology, satellite imagery) will be emphasized? What scale or scales of mapping will be used?

Item 207

In addition to a geodetic survey, how will crustal extensional deformation be assessed in the Central Basin and Range region?

Item 208

What kind of field program will be carried out to identify and study examples of coupling of faulting and dike intrusion and when will this field work take place?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
### Tectonics
### Task 4. Field Investigations to Assess Estimates of Late Neogene and Quaternary Strain and to Support Development and Assessment of Alternative Models of Late Neogene through Quaternary, and Contemporary Tectonic Development of the Central Basin and Range Region (continued)

Item 209

What is the status of the field investigations? How do these field investigations compare to tectonic and structural studies elsewhere in the Central Basin and Range region?

Item 210

How will uncertainties related to changes in extent, direction, and patterns of in-situ stress, strain and displacement conditions be assessed using refined studies of the regional and local tectonic history?

Item 211

How many of the four primary objectives of Task 4 have been completed and how will these data be incorporated in subsequent tasks as well as other CNWRA projects?

Item 212

Is there current participation of CNWRA and NRC staff with the NRC-funded GPS project managed by Brian Wernicke (Cal Tech)?

## TECHNICAL ASSESSMENT AREA
## Tectonics
### Task 4. Field Investigations to Assess Estimates of Late Neogene and Quaternary Strain and to Support Development and Assessment of Alternative Models of Late Neogene through Quaternary, and Contemporary Tectonic Development of the Central Basin and Range Region (continued)

Item 213

What is the accuracy and precision of the GPS system for the benchmark stations established in a transect across Yucca Mountain? What are the results so far of the GPS project?

Item 214

Why is the Black Mountain area of the Death Valley region suggested as a possible tectonic analog to the deep structure setting beneath Yucca Mountain and in what ways will this analog be useful for interpretation of the structural-tectonic regime of the Yucca Mountain area?

Item 215

How has the Landers 1992 earthquake with its associated geometry and slip pattern of faults been studied and compared to potential fault displacement in the Yucca Mountain area?

Item 216

What other areas are currently under study as seismic-tectonic-volcanic analogs to the Yucca Mountain area?

## TECHNICAL ASSESSMENT AREA
## Tectonics
## Task 5. Assessment of Geochronological Methods for Dating and Characterizing Fault Slip and Seismic Events

Item 217

What is the status of Task 5?

Item 218

What are the assumptions, sources of uncertainty, and limitations of field methods employed to determine fault slip?

Item 219

How will slip rate calculations be addressed, given the uncertainties of slip mode, slip rate, and general lack of identifiable marker beds?

Item 220

In addition to detailed cross-section mapping of trenches emplaced across a fault zone, what other methods are currently used (or will be used) in the field to interpret occurrence and periodicity of fault slip by the CNWRA investigators?

## TECHNICAL ASSESSMENT AREA
## Tectonics
### Task 5. Assessment of Geochronological Methods for Dating and Characterizing Fault Slip and Seismic Events (continued)

Item 221

What is the status of literature review of geochronological methods for dating fault zones? How will these data be compiled and catalogued?

## TECHNICAL ASSESSMENT AREA
## Tectonics
### Task 6. Analysis of Database and Remodeling of Tectonic Processes and Geologic Deformation Affecting the Central Basin and Range Region

Item 222

* What is the status of Task 6?

Item 223

What is the status of modeling of the tectonic processes and geologic deformation affecting Central Basin and Range?

Item 224

Do correlations exist on various spatial and temporal scales with respect to fault slip, earthquake seismicity, and crustal scale strain?

Item 225

How will modeling be judged such that seismo-tectonic models proposed by DOE can be confirmed as rigorous and accurate by NRC technical staff?

* This question can be answered before the audit in order to free up time for other questions.

## TECHNICAL ASSESSMENT AREA
### Tectonics
### Task 6. Analysis of Database and Remodeling of Tectonic Processes and Geologic Deformation Affecting the Central Basin and Range Region

Item 226

What is the status of x-ray tomography techniques and their application to modeling in Task 6?

## TECHNICAL ASSESSMENT AREA
### Tectonics
### Task 7. Semi-Annual Research Report Preparation

Item 227

* What reports have been prepared so far? How have the reports been published? Are these reports available for review?

* This question can be answered before the audit in order to free up time for other questions.