# OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

## QUALITY ASSURANCE AUDIT PLAN

## FOR AUDIT YM-ARP-95-20

## OF THE

## UNITED STATES GEOLOGICAL SURVEY

## YUCCA MOUNTAIN SITE, NEVADA AND DENVER, COLORADO

## SEPTEMBER 6 THROUGH 7 AND 11 THROUGH 15, 1995

**Prepared by:** _____ **Date:** 8/9/95
**Kenneth O. Gilkerson**
**Audit Team Leader**
**Yucca Mountain Quality Assurance Division**

**Approved by:** _____ **Date:** 8/9/95
**Donald G. Horton**
**Director**
**Office of Quality Assurance**

## 1.0 SCOPE

This performance based audit of the U.S. Geological Survey (USGS) is a limited scope audit to be conducted by a team of auditors from Yucca Mountain Quality Assurance Division (YMQAD). The audit will focus on the implementation of the Quality Assurance (QA) program for specific activities. The activities sampled will consist of a vertical flow from where data is collected in the field on geologic framework of the site, combined with hydrologic data from the Unsaturated Zone (UZ), and then analyzed and incorporated in the UZ model. Although others may be included, specific areas which will be sampled are:

| Work Breakdown Structure: | Title: |
|---|---|
| 1.2.3.2.2.1.2 | Structures Features within the Site Area |
| 1.2.3.3.1.2.3 | Percolation in the UZ - Surface Based Study |

## 2.0 AUDIT SCHEDULE

| | |
|---|---|
| Field Pre-audit Team/Observer Meeting | 7:30 a.m.<br>September 6, 1995<br>Yucca Mountain Site, Nevada |
| Field Pre-audit Conference | 8:30 a.m.<br>September 6, 1995 |
| Field Audit Activities | 9:30 a.m. - 3:30 p.m.<br>September 6, 1995<br><br>8:00 a.m. - 3:30 p.m.<br>September 7, 1995 |
| Preaudit Team/Observer Meeting | 8:00 a.m.<br>September 11, 1995<br>Denver, Colorado |
| Preaudit Conference | 9:00 a.m.<br>September 11, 1995 |
| Audit Activities | 10:00 a.m. - 4:00 p.m.<br>September 11, 1995 |

| | |
|---|---|
| Audit Activities (Continued) | 8:00 a.m. - 4:00 p.m.<br>September 12-14, 1995 |
| | 8:00 a.m. - 11:30 a.m.<br>September 15, 1995 |
| Post-audit conference | 1:00 p.m.<br>September 15, 1995<br>Denver, Colorado |

A daily briefing of USGS management will be held at a time agreed in the preaudit conference, and an Audit Team/Observer meeting at 4:15 p.m. will be held daily to communicate audit progress and to discuss potential deficiencies.

## 3.0 REQUIREMENTS TO BE AUDITED AND APPLICABLE REFERENCES

The requirements to be audited will be contained in a performance based checklist. This checklist will be developed from the latest available revision of approved and issued USGS QA program procedures, study plans, technical procedures, and performance objectives established.

The conduct of the audit will be guided by the documents (latest revision) listed below:

- Quality Assurance Procedure (QAP) 18.2, "Audit Program"
- Administrative Procedure (AP) 16.1Q, "Performance/Deficiency Reporting"
- AP 16.2Q, "Corrective Action and Stop Work"

## 4.0 ACTIVITIES TO BE AUDITED

A performance based audit evaluates products and activities to determine the degree to which they meet program requirements and management commitments and expectations. This evaluation of process effectiveness and product acceptability will be based upon:

- Satisfactory completion of the critical process steps
- Acceptable results and quality of the end product
- Documentation that substantiates quality of products
- Performance of trained and qualified personnel
- Implementation of applicable QA program elements

## 5.0 AUDIT TEAM MEMBERS

Kenneth O. Gilkerson, YMQAD, Las Vegas, Nevada, Audit Team Leader
Alan W. Rabe, YMQAD, Las Vegas, Nevada, Audit Team Leader-in-Training
James Blaylock, YMQAD, Las Vegas, Nevada, Auditor
Roger Henning, Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O), Las Vegas, Nevada, Technical Specialist - Hydrology
Ralph Rogers, CRWMS M&O, Las Vegas, Nevada, Technical Specialist - Geology
Bill Nelson, CRWMS M&O, Las Vegas, Nevada, Technical Specialist - Hydrology

## 6.0 AUDIT CHECKLIST

The following checklist will be used during the audit:

YM-ARP-95-20, Performance Based Checklist

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## QUALITY ASSURANCE CHECKLIST

| | | | |
|---|---|---|---|
| ORGANIZATION EVALUATED<br>USGS | [x] EXTERNAL<br>[ ] INTERNAL | [x] AUDIT<br>[ ] SURVEILLANCE | PREPARED BY Kenneth O. Gilkerson DATE 8/25/95 |
| DATES OF EVALUATION<br>Sept 11-15 1995 | | | |
| CONTROLLING DOCUMENT (Title, Number, Revision) | | | ACTIVITY EVALUATED |

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| | Kenneth O. Gilkerson, ATL<br>Alan W. Rabe, ATL in Training<br>James Blaylock, Auditor<br>Roger Henning, Technical Specialist<br>Ralph Rogers, Technical Specialist<br>Bill Nelson, Technical Specialist | | |

* INDICATE RESULTS: SATISFACTORY (SAT), UNSATISFACTORY (UNSAT), NOT APPLICABLE (N/A)

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## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| | GENERAL QUESTIONS SITE UNSATURATED ZONE STUDIES | | |
| A-1 | Review the qualifications and relevant experience of the personnel involved in these studies have. What training relative to these activities has been performed and documented? Determine if required training and levels of experience were established prior to the selection of personnel for these tasks. Examine the training/qualifications of selected personnel during the audit. | | |
| A-2 | Have adequate management resources been provided in order to meet desired objective, i.e., personnel, equipment. What are the feedback and communications mechanisms from the task achievers to management? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| A-3 | Determine if scientific notebooks and /or technical procedures were utilized during the studies. If so, do they meet the YMP requirements? | | |
| A-4 | What is the intended use of the data generated from these studies Have there been any requests for this data from the design groups? Was it qualified and submitted into the technical database? Or is this data strictly used to support (or not support) site characterization? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| A-5 | Where is the intended use of the data from these studies described in written document? What is the specific value of these studies relative to proposed repository? Will this data be used to support licensing? | | |
| A-6 | Determine if the timing of completion of these activities is consistent with project milestones. | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| A-7 | Have required equipment and M&TE been identified and obtained? Determine where it is identified and how it was obtained (procured). | | |
| A-8 | Do the studies require equipment to be qualified in any manner? What controls or parameters are established...where...? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| A-9 | Determine if the data obtained in these studies have been analyzed; and by whom and how? | | |
| A-10 | Have reports been generated and reviewed? What type of reviews have been performed to date (external/internal)? How documented? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| A-11 | Are there any completed products to date relative to the studies? Have they been accepted by DOE? Were Peer Reviews used to accept them? | | |
| A-12 | Determine if data or reports have been formally submitted into the YMP Technical database and records system. | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| | Stratigraphic Relations and Hydrologic Properties in the PTn | | |
| B.1-1 | This work was done under Study Plan 8.3.1.4.2.1, Table 2.1-1 in that Study Plan list parameters to be characterized under this study. How many of those are addressed in this particular report and how were they characterized. | | |
| B.2-1 | How did you identify boreholes to include in this study and how did you pick out crop location for measured sections? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| B.2-2 | On the basis of your results so far, have you identified additional outcrop locations or additional boreholes, either existing or proposed, that would be especially useful for extending or clarifying your results? | | |
| B.3-1 | The text states: "Lithology is the principal criterion used to subdivide the formations." Was lithology determined by hand sample description only, or were thin sections examined? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| B.3-2 | How were criteria beyond lithology characterized and quantified. | | |
| B.3-3 | The text mentions distinctive marker horizons and distinctive characteristics for at least some units Which ones were most useful and why? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| B.4-1 | Alteration is discussed on p. 22 and elsewhere, and is interpreted as resulting from several different processes. What is the mineralogy and geometry of the altered cones? Why do you interpret some of it as possibly resulting from "funarolic" activity? | | |
| B.4-2 | Unit E of Tpbt3 is interpreted as composed of several pyrodasitc flow deposits. What is the evidence for this interpretation? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| B.4-3 | What features or characteristics were most useful for interpreting the origin of the other units that were studied? | | |
| B.4-4 | Initial data suggests that several primary and secondary features of the rocks, such as welding, devitrification, and alterations, significantly affect hydrologic properties. How will is the distribution of these features characterized? What additional data could be collected to improve this characterization? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | *<br>RESULTS |
|---|---|---|---|
| B.4-5 | Reported data suggests a vertical asymmetry at the upper and lower contacts of the PTn with respect to the magnitude of hydrologic properties. Current plans call for test alcoves in the north ramp of the ESF at the upper and lower contacts of the PTn. Do these results indicate that test strategies should be modified or implemented differently in these two alcoves? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| | Fracture Character of the Paintbrush Tuff... | | |
| B.1-1 | This work was done under Study Plan 8.3.1.4.2.2. Table 2.2-1 in that Study Plan lists parameters to be characterized under this study. how many of these are addressed in this particular report and how were they characterized? | | |
| B.2-1 | How did you identify outcrop locations to be used in this study? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| B.2-2 | Fracture studies for the map areas were done under GP-12, Revision 1. Can we see the records package(s) for these studies? | | |
| B.2-3 | On page 30 it states that "The length cutoff (1.5m) used provides a good representation on the fraction fabric." How was it determined that this cutoff leads to a "good representation?" | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| B.2-4 | Supplemental data was collected at 16 sites. Which procedure was used for this, HP-246? Can we see the records package(s) for studies? | | |
| B.2-5 | The terminology used to describe fracture characteristics in Appendix 4 does not appear to be entirely consistent with that defined in procedure HP-246 or GP-12, Revision 1. Is there a reason for this variation and is it documented? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| B.3-1 | A number of criteria are presented for defining fracture type and relative timing. Which have proven to be the post useful? How consistent are they? | | |
| B.3-2 | P. 59 Lack of mineral coatings on fractures suggests lack of fracture controlled flow. This is an important observation. Is there any alteration in the rock that can be related to fracture controlled flow channels? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| B.3-3 | Pavement FS-2 is near a mapped strand of the Solitario Canyon fault zone. Is there any indication that this fault strand influenced fracture development of this pavement? | | |
| B.3-4 | P. 69 "Stratabound extension joints commonly slow renewed growth as an accommodation to increasing slip." What is the evidence for this? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| B.3-5 | P. 71 "Small but consistent strike differences between these could be the result of differences in the shape if the Mohr failure criterion for units with very different mechanical properties." How does the shape of the Mohr failure envelope explain this observation? Could this be explained in terms of other rock properties? | | |
| B.3-6 | How were the influences of welding, lithology, and alteration separated in order to interpret their effect on fracture style and intensity? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| B.3-7 | P. 95 "Most fractures of length greater than 1 meter were measured." But earlier 1.5 meters is specified as a cutoff. Isn't an unsystematic factor being introduced into the data here? | | |
| B.3-8 | P. 95 "None of the distributions could be approximated by a power low curve." This is an important conclusion, but do you really have the data to support it, given a 1.5 meter cutoff for fracture measurement? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| B.3-9 | The reported data suggest some conclusion relative to fracture connectivity through the PTn. What additional data could be collected to improve our understanding of this problem? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| | In Situ Borehole Instrumentation and Monitoring Data (October 25, 1994 through April 12, 1995) for USW NRG-7a and USW NRG-6, Yucca Mountain, Nye County, Nevada (initial report), May 31, 1995. | | |
| C.1-1 | This report was scheduled for a March 1995 milestone and has yet to be submitted to the DOE as a deliverable. What problems or restraints have been identified relative to this product. Were adequate management resources available? Did the scope change relative to the identified deliverable? Determine when this deliverable will be submitted. | | |

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|---|---|---|---|
| C.1-2 | What type of review(s) has this report been through? Were or is there mandatory comments? If so, how resolved?<br><br>Are other reports in progress for these boreholes...say from April through August 1995? If so, how is this data distinguished and differentiated from previous date from the same borehole? How is it submitted? | | |

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|---|---|---|---|
| C.2-1 | Are your products final results or do they feed into Subject Area Synthesis Reports, Process Models, Repository Design, Performance Assessment, or License Application?<br><br>If so, how are the data being used? And how do you (as the originator) believe the product should be used? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.2-2 | Determine how these boreholes were drilled<br><br>a. Was any type of conditioning, development, or cleanout necessary prior to instrumentation?<br><br>b. Under whose supervision was the field work noted above?<br><br>c. Who determined if they were ready to be instrumented after completion?<br><br>d. How was that determination made?<br><br>e. How were the hole instrumented? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.2-3 | Determine which zones were selected to monitor and what time periods to log and analyze. | | |
| C.2-4 | Determine how the raw and processed data is analyzed<br><br>a. What procedures cover the way data is reduced and presented?<br><br>b. Is other data from other sources used in your analysis?<br><br>c. If so, who provides it and how are you assured that it is correct and appropriate for your use?<br><br>d. How are the data being used, and how do you (as the originator) believe the product should be used? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.2-5 | What work do you manage under WBS 1.2.3.3.1.2.3?<br><br>a. At which physical locations does the actual work occur?<br><br>b. How do you synchronize work at different locations?<br><br>c. How does work done by your team ultimately feed into the 3-D UZ Site-Scale Model?<br><br>d. What are the data needs that generate the need for this work?<br><br>e. Where are these data needs documented?<br><br>f. How do you collect data to meet these needs?<br><br>g. How do you select which tests, data, or results are necessary to meet stated needs? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| C.2-6 | What general types of equipment are used?<br><br>a. Where is this equipment operated, calibrated, maintained, and documented?<br><br>b. How are the results from the testing recorded, processed, and stored? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.2-7 | How is the raw and processed data analyzed?<br><br>a. What procedures cover the way data is reduced and presented?<br><br>b. Is other data from other sources used in your analysis?<br><br>c. If so, who provides it and how are you assured that it is correct and appropriate for your use?<br><br>d. How so you synthesize data to develop conclusions and recommendations? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| | WBS 1.2.3.3.1.2.3 (Milestone 3GUI421M)<br>In-situ Borehole Instrumentation and Monitor Data<br>(Oct.25, 1994 through Apr. 12, 1995)<br><br>OVERVIEW | | |
| C.3-1 | What study plan covers this work? How does this work address the goals of the study plan? What has already been accomplished? And what needs to be accomplished yet (in an overview since -- details will be addressed later in the audit)? | | |
| C.3-2 | What other borehole installations than USWNRG-7a and USWNRG-6 have been instrumented with this package of thermmisters, pressure transducers, thermocouple psychrometers, etc? How many next year and expected in future years? Could we also visit UZ 4 and UZ 5 installations? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| | SPECIFICS | | |
| C.3-3 | What were the special borehole requirements in preparation for instrument package installation? | | |
| C.3-4 | Discuss any special considerations in the location of the individual packages in borehole 6 or 7a. | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.3-5 | Describe the sensors making up the installation at different depths in the boreholes. What back up instrumentation, if any, is involved? | | |
| C.3-6 | Review the specific sensor calibration records pertinent to USWNRG-6 and USWNRG-7a. | | |

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|---|---|---|---|
| C.3-7 | What original and as-built construction records are available and elaborate on some of the materials involved in placement in the borehole? | | |
| C.3-8 | What prepatory and preliminary sensor data steps were used before routine data readings on 3.5 to 5 hour, beginning January 6, 1995? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.3-9 | Were any particular problems encountered during installation and start up observations? How were they solved? And what was learned for possibly improving subsequent installations? | | |
| C.3-10 | What data is available? In what data transmittal form? And how many other potential users of the data obtain the data? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.3-11 | Summarize some particularly pertinent results in the data observations, reported to date. | | |
| C.3-12 | Outline some other YMP projects that will be using this data. | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| C.3-13 | How is this continuing data feed now and in the future to be used in the UZ modeling and synthesis work in YMP? | | |
| C.3-14 | What internal site characterization modeling is planned or underway to more fully interpret and use this data? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| C.3-15 | Is specific air phase modeling planned that will utilize the air pressure data to evaluate pneumatic effects in the mountain as observed through different boreholes? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| | Questions to the UZ Modeling are as follows: | | |
| D-1 | What are the technical qualifications of the Principal Investigator(s) for the unsaturated zone modeling? | | |
| D-2 | Are the verification of education and experience verified by appropriate management? | | |

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|---|---|---|---|
| D-3 | Are the PIs trained and current in that training to the appropriate technical and administrative procedures? | | |
| D-4 | Is any part of the UZ modeling task performed by subcontract? | | |

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|---|---|---|---|
| D-5 | If (D-4) is affirmative, what is the scope of work and is the procurement document consistent with the description? | | |
| D-6 | What are the USGS PI responsibilities relative to coordinating, overseeing, and reviewing subcontractor work? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| D-7 | How do the modeler interface with the PIs who collect field data to assure that the data gathered is appropriate for modeling needs? | | |
| D-8 | What mechanisms exist for modelers to review data as it is gathered to provide feedback to field personnel? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| D-9 | What are the outputs of the UZ modeling? | | |
| D-10 | Who uses the output and what coordination exists between modelers and users? | | |
| D-11 | Have specific models been identified for development? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| D-12 | What software configuration management controls are in place for identified software? | | |
| D-13 | What are the sources for data input for UZ modeling? | | |
| D-14 | Are these sources included in the technical data base? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| | WBS 8.3.1.2.2.9, "Unsaturated Zone Modeling and Synthesis." | | |
| | Overview | | |
| D-15 | What study plan covers this work? How does this work address the goals of the study plan? And what has already been accomplished yet (in an overview sense - details will be addressed later in the audit)? | | |
| D-16 | Discuss how the several other sit characterization plans in the 8.3.1.2.2 series culminate in the modeling and synthesis effort. | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| D-17 | Outline the primary objective of the unsaturated zone Modeling and synthesis study and how they are being accomplished. | | |
| | Specifics | | |
| D-18 | How and to what extent was three dimensional geologic stratigraphic model used in:<br><br>a) The preliminary three- dimensional site- scale model of Yucca Mountain (LBL/USGS) and,<br><br>b) The intermediate three-dimensional LBL/USGS site-scale unsaturated zone multi-phase flow model of YM on which development began in October, 1994 and to be completed mid FY-1996. | | |

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|---|---|---|---|
| D-19 | Contrast the stratigraphic basic data used in items a) and b) in checklist question D-18. | | |
| D-20 | Compare the numerical guide used in the models a) and b) in checklist questions D-18, i.e., mesh size, number of nodes, external boundaries, etc. | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| D-21 | How much calibration work was done on the preliminary site-scale unsaturated zone flow model? | | |
| D-22 | Outline the fault zones included and how they were treated in the preliminary site-scale unsaturated zone flow model. | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| D-23 | Discuss the model calibration work completed and planned for the intermediate site-scale unsaturated zone model. | | |
| D-24 | Discuss and contrast the spatial deep percolation rates used in the preliminary and intermediate unsaturated zone models. | | |

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|---|---|---|---|
| D-25 | To what extent is the new spatially infiltration or deep percolation rate map incorporated into the present intermediate site-scale unsaturated zone model? | | |
| D-26 | Outline the grid stratigraphic descriptions of the Paintbrush (PTn) used in the preliminary and intermediate models. | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| D-27 | Discuss the current perceived significance of the PTn to the overall modeling of the YMP unsaturated zone. | | |
| D-28 | Describe the way the detailed air phase pressure data from in-situ borehole instrumentation is being used to help calibration of the unsaturated zone models. | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
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| D-29 | What are the major present concerns in calibrations of the site-scale multi-phase unsaturated zone flow models? | | |

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| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS Record objective evidence reviewed, method of verification, personnel contacted | RESULTS |
|---|---|---|---|
| | Preliminary Development of the LBL/USGS 3-D Site-Scale Model | | |
| D-30 | Table 3.1-1 of Study Plan 8.3.1.2.2.9 lists hydrologic issues, hypothesis and representation for the unsaturated zone hydrologic system. Would you change or add anything to the discussion of the Paintbrush Tuff non welded unit today? | | |
| D-31 | Is the definition of the Paintbrush hydrogeological unit given in this report the same as the definition of PTn in other project reports? | | |

## QUALITY ASSURANCE CHECKLIST (continuation sheet)

| ITEM NO. | CHARACTERISTICS TO BE EVALUATED | REMARKS<br>Record objective evidence reviewed, method of verification, personnel contacted | * RESULTS |
|---|---|---|---|
| D-32 | How is new data collected under study 8.3.1.4.2.1, or other studies, integrated into this modeling effort? | | |
| D-33 | Will an effort be made to subdivide the Paintbrush hydrogeological unit based on new field work that has been done with PTn outcrops? | | |

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| D-34 | Figure 9 of this report and figure 4 of the report by Moyer, Geslin, and Flint are isopack maps of the same unit, but show some discrepancies. How are these explained? | | |
| D-35 | The report by Sweatkind, et. al. on fracture characteristics of the PTn states "cooling joints of the columnar subzone terminate within the network of small, unmapped cooling joints in the upper part of the vitric zone - thus, there is probably significant connectivity between the fracture network in the welded, devitrified Tiva Canyon Tuff and the upper part of the vitric zone.: How will this conclusion effect your model? | | |

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| D-36 | As the model is developed how will decisions, such as subdividing the PTn, be made and documented? | | |
| D-37 | Will more detailed modeling efforts, in 2-D or even 1-D, be used to evaluate specific changes to the larger 3-D model? | | |

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|---|---|---|---|
| D-38 | What do you think will be the final volume included in the 3-D site-scale model? | | |
| D-39 | Given our current understanding what do you think will be the most important problems to be resolved in developing the 3-D site-scale model? | | |

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| D-40 | a. What equipment is used?<br><br>(specific questions for each piece of equipment depending on the answer to C.2-6)<br><br>b. How is this equipment operated, calibrated, maintained, and documented?<br><br>c. How are the results from the testing recorded, processed and stored?<br><br>d. What field data do you think will be critical to resolving the problems identified above? | | |