U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
OFFICE OF QUALITY ASSURANCE

AUDIT REPORT

OF THE

CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM
MANAGEMENT AND OPERATING CONTRACTOR

AT

LAWRENCE BERKELEY NATIONAL LABORATORY

BERKELEY, CALIFORNIA

AUDIT NUMBER YM-ARP-96-04
FEBRUARY 5 THROUGH 8, 1996

Prepared by: Donald J. Harris **Date:** 3/1/96
Donald J. Harris
Audit Team Leader
Yucca Mountain Quality
Assurance Division

Approved by: [signature] **Date:** 3/5/96
Donald G. Horton
Director
Office of Quality Assurance

Enclosure

1.0 EXECUTIVE SUMMARY

As a result of Performance Based Quality Assurance (QA) Audit YM-ARP-96-04, the Audit Team determined that the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) at Lawrence Berkeley National Laboratory (LBNL) in Berkeley, California, is satisfactorily implementing an effective QA program and process controls for the scientific investigations and reporting of deliverables: 3GLM105M, titled, "Analysis Paper: Performance of 3D Site Scale Model," and 3GLM107M, titled, "Analysis Paper: Sensitivity Studies Using 3D Model," except for those specific deficiencies identified as Deficiency Reports (DR). The LBNL program examined during this audit is in accordance with the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), Quality Assurance Requirements and Description document (QARD), DOE/RW-0333P, Revision 5. These Analysis Papers deliverables are preliminary, in part due to the insufficient qualified data sets being available for use. It was noted that originally these Analysis Papers were initiated under U. S. Geological Survey's (USGS) QA program and subsequently completed under the LBNL QA program.

The Audit Team identified two deficiencies during the audit that resulted in the issuance of two DRs. DR Yucca Mountain Quality Assurance Division (YMQAD)-96-D038 addressed the failure to implement the procedural requirements for verification of education and experience of LBNL staff members and DR YMQAD-96-D039 addressed that two technical procedure preparers/reviewers had not been trained to the appropriate procedure. These conditions are described in Section 5.0 of this report. Additionally, there were six recommendations resulting from the audit which are detailed in Section 6.0 of this report.

2.0 SCOPE

This performance based audit was conducted to evaluate the effectiveness of LBNL's process controls for performing scientific investigations and generating Analysis Papers, "Performance of 3D Site Scale Model," and "Sensitivity Studies Using 3D Model." The audit was intended to determine the degree to which the resultant products meet the program requirements, and management commitments and expectations, as well as to determine that LBNL completed the work in accordance with pertinent section of the QARD.

The processes and products evaluated during the audit, in accordance with the approved Audit Plan are as follows:

PROCESS/ACTIVITY/END-PRODUCT

The two Analysis Papers selected for evaluation by YMQAD in coordination with USGS, LBNL, and the Yucca Mountain Site Characterization Office, Assistant Manager, Scientific Programs were:

1. "Performance of 3D Site Scale Model," Site Characterization Plan (SCP) 8.3.1.2.2.9, Work Breakdown Structure (WBS) 1.2.3.3.1.2.9, deliverable identification 3GLM105M.

2. "Sensitivity Studies Using 3D Model," SCP 8.3.1.2.2.9, WBS 1.2.3.3.1.2.9, deliverable identification 3GLM107M.

The audit plan identified another potential audit candidate Analysis Paper, titled, "Coupling Dual-Porosity/Site Scale," SCP 8.3.1.2.2.8, WBS 1.2.3.3.1.2.8, deliverable identification 3GLF101M. This deliverable was still in process of being drafted; therefore, it was not possible to audit it.

The performance based evaluation of process effectiveness and product acceptability was based on: 1) proper implementation of the procedure's critical process steps; 2) use of trained and qualified staff working effectively; 3) documentation that substantiated the quality of the products; 4) acceptable results and quality of the end products; and 5) implementation of applicable QA program elements as they apply to the deliverables.

TECHNICAL AREAS

The audit was a technical evaluation of the activities identified in the two Analysis Papers listed above.

QA PROGRAM AREAS

In addition, a sample of the QA program requirements and controls as they applied to the two Analysis Papers, were examined to evaluate the degree of compliance. The following QA program elements were evaluated:

2.0 QA Program (Personnel Selection, Indoctrination, Training, and Qualification)
4.0 Procurement Document Control
5.0 Implementing Documents (Technical Procedures)
12.0 Control of Measuring and Test Equipment
16.0 Corrective Action
Supplement I Software (Transport of Unsaturated Groundwater and Heat [TOUGH]2)

Supplement II	Sample Control
Supplement III	Scientific Investigations (Control and Transfer of Technical Data and Scientific Notebooks)

3.0 AUDIT TEAM AND OBSERVERS

The following is a list of the audit team members and their assigned areas of responsibility:

Name/Title/Organization	QA Program Elements/Requirements Processes, Activities or End-products
Donald J. Harris Audit Team Leader, YMQAD	QA Program sections directly related to support the products. QA Sections 4.0, 12.0, 16.0, and Supplement II
James Blaylock, Auditor, YMQAD	QA Sections 2.0, 5.0, Supplement I, and Supplement III
Dr. Ronald M. Linden, Technical Specialist, CRWMS M&O	Supplement III and Analysis Paper, "Performance of 3D Site Scale Model."
Dr. Keith M. Kersch, Technical Specialist, CRWMS M&O	Supplement I, III, and Analysis Paper, "Sensitivity Studies Using 3D Model."

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

A preaudit meeting was held at LBNL's offices in Berkeley, California on February 5, 1996. A daily debriefing and coordination meeting was held with LBNL management and staff, and daily audit team meetings were held to discuss issues, potential deficiencies, coordinate the pace of the audit, and to discuss process recommendations. The audit was concluded with a postaudit meeting held at LBNL's offices in Berkeley, California on February 8, 1996. Personnel contacted during the audit are listed in Attachment 1. The list includes those who attended the preaudit and postaudit meetings.

5.0 SUMMARY OF AUDIT RESULTS

5.1 Program Effectiveness

The audit was performed based on direct observations of the activities in process, interviews with LBNL staff, and review of pertinent documents for performance based information gained throughout this process, in order to make a determination whether or not the performance was satisfactory.

The Audit Team concluded that, in general, with the exception of areas identified as deficiencies process controls are being effectively implemented by LBNL for the scope of this audit; however, the Audit Team concluded that currently the "Performance of 3D Site Scale Model," and "Sensitivity Studies Using 3D Model," Analysis Papers deliverables are preliminary, in part due to insufficient qualified data sets being available for use. It was noted that originally the two Analysis Papers were initiated under the USGS QA program, but completed under the LBNL QA program, after the LBNL QA program was approved by the OCRWM Office of Quality Assurance (OQA) on July 21, 1995.

There were two deficiencies identified by the Audit Team. These conditions are described in Section 5.5.2 of this report. Additionally, there were six recommendations resulting from the audit which are detailed in Section 6.0 of this report.

5.2 Stop Work or Immediate Corrective Actions Taken

There were no Stop Work Orders, immediate corrective actions or related additional items resulting from this audit.

5.3 QA Program Audit Activities

OQA approved the LBNL QA program for implementation on July 21, 1995; consequently, there was limited work accomplished to the LBNL QA program. Evidence of this implementation focused on LBNL activities conducted in generating the Analysis Papers. Therefore, there was limited evidence of program implementation. The following QA program sections were evaluated and determined not to be required for development of the two Analysis Papers: Section 4.0, "Procurement Document Control;" Section 12.0, "Control of Measuring and Test Equipment;" and Supplement II, "Sample Control."

In addition, there was limited implementation of Supplement I, "Software." Section 2.0, "Quality Assurance Program," (Personnel Selection, Indoctrination, Training, and Qualification), Section 5.0, "Implementing Procedures," (Technical Procedures), Section 16.0, "Corrective Action," and Supplement III, "Scientific Investigations," were evaluated and it was determined that adequate QA controls were being implemented by LBNL.

Section 2.0, "Quality Assurance Program"

Personnel selection, indoctrination, training, and qualification records were reviewed for those individuals working on the identified products. In the course of the review two deficiencies were identified: Two technical preparers/reviewers had not been trained to the appropriate procedure and the verification of education and experience did not meet the procedural requirements. These deficiencies were identified as DRs YMQAD-96-D039 and YMQAD-96-D038, respectively. Other than these areas, Program Element 2.0 was considered satisfactory.

Section 5.0, "Implementing Documents"

Four Technical Procedures, 1) Yucca Mountain Site Characterization Project (YMP)-LBNL-TIP-KHL-1.0, Revision 0, "Magnetalellunis Measurements;" 2) YMP-LBNL-TIP-ELM 1.0, Revision 0, "VSP and Crosshole Tomographic Surveys;" 3) YMP-LBNL-TIP-ELM 3.0, Revision 0, "Deep Seismic Reflection Study of the Tectonic Environment;" and 4) YMP-LBNL-TIP-ELM, 2.0, Revision 0, "Gravity Methods," were examined and found to have been developed, reviewed, approved, and issued in accordance with LBNL's procedural requirements.

Section 16.0, "Corrective Action"

A review of four YMQAD, one USGS, and ten LBNL deficiency documents, identifying conditions adverse to quality since the inception of LBNL's QA program was performed. It was determined that the deficiency documents were being processed in both a timely and effective manner.

Supplement I, "Software"

One of the major tasks by LBNL is the validation, verification, and baselining of the TOUGH2 Modeling Code. The task was nearing completion during the audit; the documentation of the model test cases, and a users manual had been completed; however, controlled copies had not been distributed to Yucca

Mountain Project program users. The code is used well beyond YMP such that non project users will receive copies from Oak Ridge. LBNL will make distribution to Yucca Mountain Project users. At the present time the LBNL procedures do not delineate the specific authorities or responsibilities within the LBNL organization for the control of distribution. LBNL will describe those authorities and responsibilities prior to making distribution of the TOUGH2 code.

Supplement III, "Scientific Investigations"

Two scientific notebooks associated with the two deliverables were examined: YMP-LBNL-GBS 1.2 and YMP-LBNL-GBS 1.3. Both notebooks were bound, paginated notebooks with the required entries. In particular, the Audit Team determined that the scientific notebook YMP-LBNL-GBS-1.3 generated by Mr. Yu-Shu Wu was exemplary and should serve as a model in meeting the YMP's expectations. This notebook had excellent detail, entries were signed and dated and corrections were as prescribed by YMP-LBNL-QIP-SIII.0.

Control and Transfer of Data
Only a single Technical Data Information Form (TDIF) has been generated by these tasks: LB 092995312293.001. the TDIF met all procedural requirements. At the present time no completed records packages have been transmitted to the records center.

Data Usage
LBNL has been using all available data for the modeling exercise; LBNL has a matrix referencing the data source by TDIF and the status of the data. Hence, LBNL has traceability and the status of the information well in hand and the process was determined to be effective.

A summary table of audit results is provided in Attachment 2. The details of the audit evaluation, along with the objective evidence reviewed, are contained within the audit checklist. The checklist is kept and maintained as a QA record.

5.4 Technical Audit Activities

The performance based QA audit of LBNL focused on the two deliverables "Performance of 3D Site Scale Model," (Deliverable 3GLM105M) and "Sensitivity Studies Using 3D Model," developed under study plan 8.3.1.2.2.9, "Site Unsaturated Zone Modeling and Synthesis."

The two deliverables share much in common; indeed, the calibration and sensitivity studies of deliverable 3GLM107M form the basis upon which the performance analysis, contained in deliverable 3GLM105M, was evaluated. Consequently, the audit of these two deliverables was conducted concurrently with discussions commonly investigating and/or incorporating aspects of both deliverables.

The LBNL QA program has only recently been approved and the brief sample examined demonstrated an effective implementation of the QA goals of the project. All investigators questioned appeared to be technically well qualified and embraced the QA program.

A checklist of technical questions was developed for each of the products being audited. The authors/Principal Investigators (PI) were available to address questions and provide backup information.

Specific questions raised and technical topics evaluated are addressed in the following evaluation and analysis below.

1) Evaluation and analysis of the "Performance of 3D Site Scale Model," (Deliverable 3GLM105M) and "Sensitivity Studies Using 3D Model," developed under study plan 8.3.1.2.2.9, "Site Unsaturated Zone Modeling and Synthesis."

   This analysis paper presents the results of an evaluation of the performance of the LBNL/USGS 3D Unsaturated Zone SSM. The stated objective of this paper is the verification of the site-scale flow model of the unsaturated zone at Yucca Mountain through comparison of the model predictions with data acquired from newly-drilled boreholes. An appropriate submodel capable of capturing key processes controlling saturations and water potentials is subjected to inverse modeling to determine a set of effective parameters representative of the conceptual model. Included in the verification effort is prediction of the response of gas pressures to atmospheric boundary conditions, a comparison with observed data to evaluate the performance of the gas-flow model, and estimation of the geothermal conditions at the site.

   The submodel used in this investigation consists of saturations and water potential data from thirteen boreholes. Assuming that moisture flow at Yucca Mountain is predominantly vertical, the submodel was

constructed by extracting vertical columns representing these borehole locations from the SSM. Thus, the submodel consists of a set of horizontally disconnected one-dimensional pillars which share discretization, zonation, and boundary conditions with the SSM. Estimation of a consistent parameter set representative of all boreholes is possible because the hydrostratigraphy of the SSM is maintained and the individual rock columns share common rock property parameter values for the hydrogeologic units.

Development of the submodel assumes that the saturation and water potential profiles reflect steady-state conditions under a constant infiltration rate (determined from model calibration). Matrix flow is approximated using the van Genuchten model, and the equivalent continuum approximations is employed to handle fracture flow in the welded hydrogeologic units.

Using ITHOUGH2, simultaneous inversion of all saturation and water potential measurements contained in the submodel was conducted to obtain parameter estimates of permeability, and the alpha- and m-parameters of van Genuchten's characteristic curves for each of the seventeen hydrogeologic units defined in the SSM. It was determined that the saturation and water potential data do not contain enough information for an independent determination of hydrogeologic parameters.

Significant improvement in the optimization process could be realized if the data sets at the modelers' disposal were more robust. Much of the water potential data shows a large degree of scatter and consequently only a minor improvement from the inversion process is achieved for the water potentials. Also, due to the model assumption that no fracture flow occurs for the saturation levels observed in the field, saturation profiles can only be matched with a small infiltration rate (estimated at 0.019 mm/yr).

Inspection of the various saturation and water potential profiles shows some major differences between field/laboratory data and calibrated submodel. However, it was not the purpose of this study to duplicate saturation or water potential profiles observed at individual boreholes, but rather to develop a consistent parameter set that best reproduces the overall hydrogeologic system behavior at Yucca Mountain.

An analysis and prediction of 3D gas flow and geothermal conditions was also conducted to evaluate model performance. Generally, the results of gas flow modeling in predicting the response of formation gas pressures to atmospheric boundary conditions are in reasonable agreement with data observed in the field. Similarly for geothermal conditions at the site, good agreement was obtained between temperature profiles simulated by the SSM and measured profiles from the available temperature logs.

In summary, the work performed demonstrated a measure of success in producing a calibrated model which provides more globally representative parameters for use in modeling the unsaturated zone at Yucca Mountain. LBNL technical staff realize the limitations of the SSM and are presently in the process of incorporating a number of modifications to the June 1995 version. Specific examples of areas which are being upgraded are provided below.

2) **Work In Progress:**

Refinement of the Conceptual Model

The hydrologic conceptual model of Yucca Mountain is being refined to include new data concerning occurrences of perched water. Studies have shown that zeolitic formation within the Calico Hills unit controls the occurrence along the interface between the Calico Hills and Topopah Spring. The results of perched water testing conducted at SD-7 indicate that this body of water is limited in volume (i.e., has not returned to previous levels after pumping) and that the Ghost Dance Fault may be acting as a barrier to eastward flow and causing the water to pond and/or drain down the fault. The possibility that the source of this water may be side slope infiltration is also being considered. By considering the volume of water observed versus the area available for infiltration, this may provide an alternative means of estimating infiltration rates.

Improvements in Fracture/Matrix Modeling

Various computer codes and tools have been developed for dealing with the treatment of fracture/matrix unsaturated flow process. These include models for the analysis of sorptivity data, relations between apertures, asperities, and hydraulic conductivities of fractures, effective hydraulic conductivities of fracture networks, and hysteretic behavior of welded tuffs.

Gas Flow/Calibration of Fault Properties
In addition to ongoing gas flow studies, analysis of pneumatic monitoring of the Unsaturated Zone (UZ) #4 and UZ#5 complex has indicated the presence of a previously unknown fault communicating with the Exploratory Studies Facility (ESF). This information will allow calibration of fault properties to pneumatic data.

Increase in Number of Lithostratigraphic Layers
To increase the resolution of flow processes in key lithologies (i.e., PTn), the number of Lithostratigraphic divisions has been increased. As of this audit, the original seventeen layers of the SSM have been increased to twenty-five layers

ESF Construction Phase Testing and Monitoring
Expanded sampling of matrix water and fracture for isotopic analysis has been initiated and will be incorporated as data comes in. Monitoring of construction-phase water use and moisture in the ESF continues.

Expansion of Model Boundaries
Lateral boundaries of the UZ model are being significantly expanded to include important geologic/hydrogeologic features. Preparation of draft contour and isopach maps depicting the extension of major hydrogeologic units and zeolitic boundaries is underway.

Conclusions:

The work being performed by the LBNL technical staff in evaluation of the performance of the LBNL/USGS 3D Unsaturated Zone Model has been accomplished in a competent manner by a team of well qualified professional hydrologists and scientific modelers. Communications between data collectors and modelers is well established and integration of modeling efforts and field/laboratory activities appear to be working efficiently. The analysis paper satisfactorily fulfills the milestone criteria set by the DOE's site characterization program. No deficiencies were identified during the technical portion of the audit. See Section 6.0 of this report for recommendations.

5.5 Summary of Deficiencies

The Audit Team identified two deficiencies during the audit for which two DRs have been issued.

Synopses of deficiencies documented as DRs are detailed below. The DRs generated as a result of this audit have been transmitted by letter, YMQAD:RBC-1173, dated February 20, 1996. Additionally, there were six recommendations resulting from the audit which are detailed in Section 6.0 of this report.

5.5.1 Corrective Action Requests (CAR)

None

5.5.2 Deficiency Report (DR)

As a result of the audit the following DRs were issued.

YMQAD-96-D038

YMP-LBNL-QIP 2.1, Revision 0, Modification 1, Paragraph 3.1, "Documenting the Selection of Personnel," requires the Human Resources department to evaluate that personnel education and experience verification is documented. Contrary to the requirement LBNL's YMP staff's education and experience was not verified or a documented justification for their selection was not provided.

YMQAD-96-D039

YMP-LBNL-QIP 2.1, Revision 0, Modification 1, Paragraph 3.3.6, "Documenting Training," requires the applicable manager to ensure the training is completed prior to the affected work being performed. Contrary to the requirements two Technical Procedure preparers/ reviewers had not been trained to YMP-LBNL-QIP 5.1, Revision 0, Modification 1, "Preparing Technical Implementing Procedures," prior to implementation.

5.5.3 Performance Report (PR)

None

5.5.4 Deficiencies Corrected During the Audit

No deficiencies were corrected during the audit.

5.5.5 Follow-up to Previously Identified Deficiency Documents

CAR YMP-95-051, USGS did not ensure their QA program was being implemented by their subcontractor (LBNL) and YMP-95-D016, identified a lack of training for USGS contractor Personnel at LBNL. The LBNL QA Manager, Mr. Donald Mangold, met with the USGS QA Manager, Mr. Thomas Chaney, and staff at USGS on January 30, 1996, to resolve exactly what USGS needs from LBNL in order for USGS to respond to the deficiencies. LBNL committed to provide the required input information to USGS by February 16. 1996. The proposed corrective action has not been submitted to YMQAD for evaluation at the time of the audit.

CAR YMP-95-022, Study Plan 8.3.1.2.2.9 activities under the USGS QA program were not controlled by technical procedure or scientific notebook and the Unsaturated Zone Modeling was not controlled by USGS-YMP-QMP 3.03, "Software Procedures." This CAR was closed on April 24, 1995, based on initiation of scientific notebook and initiation of software controls per USGS-YMP-QMP 3.03. Subsequently, the scientific notebooks are being controlled by YMP-LBNL-QIP SIII.0, "Scientific Investigations," and Software is being controlled by YMP-LBNL-QIP SI.0, "General Software Quality Assurance." Both activities are being performed satisfactorily.

PR YMQAD-96-P012, Records Logging was not in accordance with YMP-LBNL-QIP 17.0. This PR was closed January 18, 1996, based on procedure modification, effective January 10, 1996, which was being satisfactorily implemented.

PR YMQAD-96-P013, Approval of Technical Procedure modifications by personnel other than those allowed by LBNL procedure. YMP-LBNL-QIP 5.1, Revision 0, Modification 1, resolved this procedural problem, effective December 6, 1996. The PR was closed January 18, 1996. The technical procedure approvals are currently in accordance with the procedure.

6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for consideration by LBNL management:

6.1 Procedure YMP-LBNL-QIP SI.0, Revision 0, "General Software Quality Assurance," should be revised to delineate the specific authorities and responsibilities within the LBNL organization for accomplishing the control of software distribution.

6.2 LBNL utilizes a matrix referencing all the data in their 3D Modeling exercise. The matrix references the data source by TDIF number and the qualification status of the data. This methodology should be proceduralized in accordance with YMP-LBNL-QIP 5.0, "Quality Implementing Procedures," then cancel YMP-LBNL-QIP SIII.4Q, "To Be Verified (TBV) and To Be Determined (TBD) Monitoring System," as it contains a complex methodology that is not justified for LBNL's purpose of controlling data.

6.3 The use of borehole geophysical logging data in the 3D SSM to supplement the existing data set can be useful in several ways: 1) geophysical logs have been run in a number of boreholes not employed in the SSM performance evaluation, and so offer a ready means of expanding the data set used for model calibration; 2) geophysical logs commonly penetrate a meter or more into the surrounding formation, and so, offer the potential for obtaining more volumetrically representative values of hydrologic conditions (helpful in minimizing scaling problem of saturation data); and 3) data from geophysical logs can be compared to the data sets used in the SSM calibration to assess agreement or identify trends. Given projected funding scenarios and time constraints pertaining to model development, it is imperative that this source of data be utilized.

NOTE: LBNL does not control this data. Project efforts to qualify the geophysical data are presently underway, but at present no qualified data has been released.

6.4 Data collected under the Climate Program in the 3D SSM (paleodischarge sites, Devil's Hole record) may be useful in assessing future hydrologic conditions. The potential applications of this data should be investigated.

6.5 Better identification of the hydrogeological units on the various saturation and water potential plots would be helpful in assessing the data. This could be easily accomplished using tick marks or shading.

6.6 The documentation of verification and validation report for the TOUGH2 and ITOUGH2 codes should clearly state the range of applicability of each of the input variables.

7.0 LIST OF ATTACHMENTS

Attachment 1: Personnel Contacted During the Audit
Attachment 2: Summary Table of Audit Results

ATTACHMENT 1

Personnel Contacted During the Audit

Name	Organization/Title	Preaudit Meeting	Contacted During Audit	Postaudit Meeting
Ahlers, C.	LBNL/Senior Research Associate	X	X	X
Bandurraga, M.	LBNL/Senior Research Associate	X	X	X
Bodvarsson, G.	LBNL/ Project Manager	X	X	X
Fissekidou, V.	LBNL/Technical Data Coordinator	X	X	X
Mangold, D.	LBNL/QA Manager	X	X	X
Simmons, A.	LBNL/Program Manager	X	X	X
Wu, Yu-Shu	LBNL/PI	X	X	X

ATTACHMENT 2
Summary Table of Audit Results

AUDIT YM-ARP-96-04 DETAIL SUMMARY

QA ELEMENT/ ACTIVITIES	DOCUMENTS REVIEWED	CHECKLIST DETAILS	CAR (5.5.1)	DR (5.5.2)	PR (5.5.3)	CDA (5.5.4)	REC (6.0)	ADE-QUACY	COMP-LIANCE	OVER-ALL
PROGRAMMATIC CHECKLIST										
2.0 Quality Assurance Program	YMP-LBNL-QIP 2.1, Rev. 0, Modification 1	pp. 5-7	N	YM QAD-96-D038 & D039	N	N	N	SAT	SAT	SAT
4.0 Procurement Document Control	YMP-LBNL-QIP 4.1, Rev. 0, Modification 1, "Contract Development."	p. 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	YMP-LBNL-QIP 4.1, Rev. 0, Modification 1, "QA Contract Content."	p. 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
5.0 Implementing Documents	YMP-LBNL-QIP 5.0, Rev. 0, Modification 1	p. 4	N	N	N	N	N	SAT	SAT	SAT
	YMP-LBNL-QIP 5.1 Rev. 0, Modification 2	p. 4	N	N	N	N	N	SAT	SAT	
12.0 Control of Measuring and Test Equipment	YMP-LBNL-QIP 12.0, Rev. 0, Modification 1	p. 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

ATTACHMENT 2
Summary Table of Audit Results

QA ELEMENT/ ACTIVITIES	PROCESS STEPS/ DOCUMENTS REVIEWED	CHECKLIST DETAILS	CAR (5.5.1)	DR (5.5.2)	PR (5.5.3)	CDA (5.5.4)	REC (6.0)	ADE-QUACY	COMP-LIANCE	OVER-ALL
16.0 Corrective Action	AP 16.1Q	pp. 2 & 3	N	N	N	N	N	SAT	SAT	SAT
SI, Software	YMP-LBNL-QIP-SI.0, Rev. 0, Modification 1	p. 20	N	N	N	N	6.1	II	II	II
SII, Sample Control	YMP-LBNL-QIP-SII.0, Rev. 0, Modification 1	pp. 12-15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SIII, Scientific Investigations	YMP-LBNL-QIP-SIII.O, Rev. 0 Modification 1, "Scientific Investigations."	pp. 8-11	N	N	N	N	N	SAT	SAT	SAT
	YMP-LBNL-QIP-SIII.3, Rev. 0, Modification 1	pp. 4, 16-20	N	N	N	N	N	SAT	SAT	
TECHNICAL CHECKLIST										
1. WBS 1.2.3.3.1.2.9 Technical Evaluation of "Performance of 3D Site Scale Model," Deliverable 3GLM105M	Node Mesh Generation	p. 1	N	N	N	N	N	SAT	SAT	SAT
	Data References	pp. 2 & 3	N	N	N	N	6.2	SAT	SAT	
	Qualified vs. Non Qualified Data	pp. 4 & 5	N	N	N	N	N	SAT	SAT	
	Qualification of TOUGH2 Program	pp. 6 & 8	N	N	N	N	6.6	SAT	SAT	
	Selection of Data	pp. 7 & 9	N	N	N	N	N	SAT	SAT	

ATTACHMENT 2
Summary Table of Audit Results

QA ELEMENT/ ACTIVITIES	PROCESS STEPS	CHECKLIST DETAILS	CAR (5.5.1)	DR (5.5.2)	PR (5.5.3)	CDA (5.5.4)	REC (6.0)	ADE-QUACY	COMP-LIANCE	OVER-ALL
1. (continued)	Summary of Model Calibration	pp. 10-21	N	N	N	N	N	SAT	SAT	
2. WBS 1.2.3.3.1.2.9, Technical Evaluation of "Sensitivity Studies Using 3D Model." Deliverable 3GLM107M	Saturation and Water Data	pp. 32 & 33	N	N	N	N	N	SAT	SAT	SAT
	Development of Scale Model	pp. 24-39	N	N	N	N	N	SAT	SAT	
	Model Prediction	p. 40	N	N	N	N	N	SAT	SAT	
	Borehole and Model Lithology Comparison	pp. 41-43	N	N	N	N	N	SAT	SAT	
	Prediction Simulations	pp. 44-51	N	N	N	N	N	SAT	SAT	
	Summary	p. 52	N	N	N	N	N	SAT	SAT	
	Introduction	p. 53	N	N	N	N	N	SAT	SAT	
	Modeling and Analyses	pp. 54 & 55	N	N	N	N	6.4, 6.3 & 6.5	SAT	SAT	
	Model Description	p. 56	N	N	N	N	N	SAT	SAT	
	Simulations and Comparison	pp. 57 7 58	N	N	N	N	N	SAT	SAT	

Legend:

CDA . . . . Corrected During the Audit
II . . . . . Insufficient Implementation to determine adequacy/compliance
N . . . . . None
N/A . . . . . Not Applicable to audit products
N/I . . . . . No Implementation
REC . . . . . Recommendation
SAT . . . . Satisfactory