

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

AUDIT REPORT

OF

UNITED STATES GEOLOGICAL SURVEY

YUCCA MOUNTAIN SITE, NEVADA and DENVER, COLORADO

AUDIT NUMBER YM-ARP-95-12

June 8 through 16, 1995

Prepared by:



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Yucca Mountain Quality
Assurance Division

Date:

7/21/95

Approved by:



Donald G. Horton
Director
Office of Quality Assurance

Date:

7/24/95

1.0 EXECUTIVE SUMMARY

As a result of the Performance Based Quality Assurance (QA) Audit YM-ARP-95-12, the audit team determined that the U.S. Geological Survey (USGS) is satisfactorily implementing an effective QA program and process controls for Quaternary Faulting Studies.

The audit team identified three deficiencies during the audit that resulted in the issuance of two Corrective Action Requests (CAR). CAR YM-95-045 documents that the USGS report "Paleoseismic Investigations of the Stagecoach Road Fault, Southeastern Yucca Mountain, Nye County, Nevada" which had been submitted to the Yucca Mountain Site Characterization Office (YMSCO) for review and approval contains numerous technical errors. CAR YM-95-046 states that there is no documented evidence that mandatory comments to technical documents have been resolved prior to approving the documents, and that technical comments are being identified as "nonmandatory" that should have been "mandatory". Additionally there were five process improvement recommendations resulting from this audit which are detailed in Section 6.0 of this report.

The audit team determined that USGS personnel were competent, qualified professionals that developed good technical data, but had problems adequately depicting this information in published reports as evidenced by the two CARs cited. The technical data submitted to the Technical Data Base was found to be adequate. The team based these observations on its evaluation of four Quaternary Faulting Studies that were examined during the audit at the Yucca Mountain Site (YMS) and in Denver, Colorado.

2.0 SCOPE

The limited scope audit was conducted to evaluate the effectiveness of USGS's controls for performing Quaternary Faulting Studies in accordance with DOE/RW-0333P, Revision 2, the Quality Assurance Requirements and Description (QARD) document, Supplement III, and the Site Characterization Plans (SCP) for Quaternary Faulting Activities.

The processes/end-products evaluated during the audit, in accordance with the approved audit plan are as follows:

PROCESS /ACTIVITY/ OR END-PRODUCT

Four reports resulting from the Quaternary Faulting Studies were selected for evaluation:

1. Paleoseismic Investigations of the Stagecoach Road Fault, Southeastern Yucca Mountain, Nye County, Nevada
2. Preliminary Evaluation of the Bare Mountain Fault Zone, Tarantula Canyon, Nye County, Nevada
3. Structure of the Northern Part of the Paintbrush Canyon Fault, Yucca Mountain, Nevada
4. Tectonics Significance of the Rock Valley Fault Zone, Nevada Test Site

The performance based evaluation of process effectiveness and product acceptability was based on:

1. Satisfactory implementation of the critical process steps,
2. use of trained and qualified personnel working effectively,
3. documentation that substantiates the quality of the products, and
4. acceptable results and adequate end products.

TECHNICAL AREAS

The audit of Quaternary Faulting Studies was a technical evaluation of the activities identified in the four reports listed above.

3.0 AUDIT TEAM AND OBSERVERS

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

Name/Title/Organization

QA Program Requirements/
Processes or Products

Kenneth Gilkerson, Audit Team Leader (ATL),
Yucca Mountain Quality Assurance Division
(YMQAD)

Supplement III, Critical Process
Steps

James Blaylock, Auditor, YMQAD

Supplement III, Critical Process
Steps

Robert Harpster, Lead Technical Specialist,
YMQAD

Selected Quaternary Faulting
Studies

Jefferson McCleary, Technical Specialist,
Civilian Radioactive Waste Management
System Management and Operating Contractor,
Woodward Clyde Federal Services

Selected Quaternary Faulting
Studies

William Belke, Observer,
U.S. Nuclear Regulatory Commission (NRC)

Jack Spraul, Observer, U.S. NRC

Steve McDuffie, Observer, U. S. NRC

Harold Lefevre, Observer, U.S. NRC

Robert Brient, Observer, U.S. NRC (Southwest Research Institute)

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

A field preaudit meeting was held in the Field Operations Center (FOC) at the YMS on June 8, 1995 with USGS geologists, QA implementation staff, and NRC observers. A debriefing was held in the field on June 9, 1995 detailing issues and concerns from the field portion of the audit. A preaudit meeting was also held at the USGS offices in Denver, Colorado, on June 13, 1995. A daily debriefing and coordination meeting was held with USGS Yucca Mountain Project (YMP) Management and staff to discuss issues and potential deficiencies. A daily audit team meeting was also held each evening to coordinate the pace of the audit and to discuss issues, process recommendations and potential deficiencies. The audit was concluded with a postaudit meeting held at the USGS offices in Denver, Colorado, on June 16, 1995. 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 team determined that, in general, with the exception of areas identified as deficiencies, process controls are being effectively implemented by the USGS for Quaternary Faulting Studies. The audit assessed four studies in different stages of completion. The audit team determined that USGS scientists developed good technical data, but identified some difficulties in presenting the results in acceptable, consistent reports that had been adequately reviewed and approved.

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

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 checklists. The checklists are kept and maintained as QA Records.

5.4 Technical Audit Activities

The performance based QA audit of the USGS Quaternary Faulting Studies focused on four products and associated processes. The products consisted of the four reports identified in Section 2.0 supplied by USGS to the audit team. The processes consisted of the critical process steps identified by USGS as being necessary for the successful development of the report products. The reports provided were current in that they were still in various stages of development, review, and completion allowing the audit team to provide the USGS with real time input on their processes and products.

Technical checklist questions were developed from each report and the report authors/Principal Investigators (PIs) responded satisfactorily to all questions either in the field at the Yucca Mountain trench sites or at the USGS offices in Denver, Colorado. The following comments to each of the four reports resulting from the Quaternary faulting studies provide an evaluation for consideration in completing these and other studies.

1) "Paleoseismic Investigations of the Stagecoach Road Fault, Southeastern Yucca Mountain, Nye County, Nevada "

One characteristic of a good report is that sufficient detail is presented for the reader to come to their own conclusions. The details both in terms of the basic data presented and in the description of how that data was evaluated/analyzed, in order to arrive at the conclusions stated in the report, need to be evident. In that context, the Stagecoach Road (SCR) Fault Report is very good. The report contained all the information necessary for an independent reviewer to trace the conclusions back to the basic data, but inclusions of sample calculations for slip rate and recurrence interval would have added value. See recommendation number 5 in Section 6.0. This document will clearly be useful in supporting site characterization and project goals.

Unfortunately, due to an inadequate technical review and technical editing process, this report contains numerous technical errors that detract from the fine scientific work that was performed, degrade the final product, and diminish the confidence of subsequent reviewers or users (e.g. U.S. Department of Energy). See CARs YM-95-045 and YM-95-046. One of the major problems is lack of consistency between tables, figures, and text. For example, Table 9 of the report lists colluvial wedges that were identified in SCR trenches SCR-T1 and SCR-T2. These wedges are shown graphically on Figures 9 and 10 of the report, respectively. However, when Figure 9 and 10 are compared to the detailed logs so that the colluvial wedge sub-units can be identified, it is found that in four cases the listings in Table 9 are incorrect. This immediately raises the issue of "what was the author's interpretation?". Does he interpret the colluvial wedge for event Z in trench SCR-T3 to be units I4b, J2, and J3 as described in Table 9; or only units I4b and J2 as shown on Figure 10? If only I4b and J2 make up the wedge, then it is thinner and may represent a smaller displacement event. The reviewer must question if this is what is intended. If there is real uncertainty as to which units constitute the wedge, then this should be discussed in the text. The report in its current form generates numerous questions. The interpretations in this text are unclear because of the inconsistencies previously described.

The report does address uncertainty in the interpretation of paleoseismic events but the audit team found the discussion to be confusing. There is discussion of "two to five" and "three to five" events. It is not always clear whether the text and figures are referring to hanging wall events only, or to the whole trench. Table 9 indicates that for SCR-T1 events Z and W have high reliability so these are assumed to be the "two" events of the "two to five" discussion. However, only four hanging wall events are listed, the fifth event being in the footwall. There are five hanging wall events listed for trench SCR-T3 on

Table 9; but, the high reliability events are Z and V with event W having poor reliability. One must question if this means the "two to five" events in each trench could be different events. The uncertainty discussion also appears incomplete in that no implications are discussed. Presumably, if the hanging wall sequences were produced by two events rather than five, they would have been larger displacement events.

The uncertainty discussion might be clearer if the text presented the interpretations shown on Table 9 and Figures 9 and 10 followed by a discussion of alternate interpretations for the lower reliability events and their subsequent implications. This approach would make it more apparent to users of the report where the uncertainty lies and which interpretations are more conservative in terms of design. Another consideration for this report would be to include a clear scope statement and a brief explanation of where the report "fits" in the overall scheme of Quaternary Fault evaluations. For example, the report falls short of what the audit team would expect of a complete "paleoseismic" investigation in that there is no discussion of rupture length, rupture area, displacement or estimated magnitude per paleo-event. Since these are factors that could impact repository design, they will need to be developed; and, it would be helpful to the user to know where that information will be presented.

2) "Preliminary Evaluation of the Bare Mountain Fault Zone, Tarantula Canyon, Nye County, Nevada"

This report is intended as an article or chapter in a forthcoming USGS circular on Quaternary Fault Studies for Yucca Mountain. It is essentially a report on work in progress as two more trenches had been excavated and one of those had been logged at the time of the audit. In addition, a number of soil pits had been excavated along the trend of the Bare Mountain fault to better define, describe or correlate the different Quaternary surfaces present in the area.

Relative to the existing report, it would be clearer if the text and trench log noted that the trench was excavated as a Q4 surface that is locally mantled with Q2 age material. The discussion of the 0.5 to 1.5 cm thick laminar carbonate layer and its relationship to units 2 and 4 could also be improved. These are relatively minor points and the document is certainly an excellent report on progress achieved as of the date it was written. See recommendation 6.5.2.

In terms of achieving project goals, it is not clear what functions this report serves. According to the YMP lists of scientific reports in progress, it is not associated with a milestone. As an article in the proposed USGS circular, it would get wider distribution than as only a project document. On the other hand, by the time the circular is published this information will be out of date. The information from the additional trenches, soil pits and age dating studies may refine or modify the conclusions presented in this preliminary report. This could lead to the situation wherein a final report supporting Site Characterization and/or license application is in conflict with a published circular article on the same fault zone. The advantages and disadvantages of publishing progress reports in the USGS circular format needs to be carefully evaluated.

3) "Structure of the Northern Part of the Paintbrush Canyon Fault, Yucca Mountain, Nevada"

This report is also intended as an article in the forthcoming USGS circular. As such the previous discussion on the value of the circular in achieving project goals also applies here. The emphasis of the report is on structural mapping and relationships in the Tertiary volcanic rocks of Paintbrush Canyon. The structural information would be input to the 3-D lithostratigraphic model of Yucca Mountain. The detailed mapping examined during the audit in Denver should be useful for this purpose. However, the figures in the circular article may be too generalized to use directly.

A major concern relative to the Paintbrush Canyon fault is whether there is Quaternary faulting north of Yucca Wash. This directly impacts repository design since greater fault lengths could produce larger magnitude earthquakes. The report states that there is no evidence for Quaternary offset north of Yucca Wash, though no Quaternary studies are referenced. During discussions in Denver, the co-author speculated that there may be Quaternary offset north of Yucca Wash, but that Quaternary deposits may not be extensive enough for a definitive evaluation. Until this issue is resolved, it may be advisable to either remove any discussion of Quaternary faulting from the text or provide sufficient text and reference for a reader to understand that the issue is still to be resolved. See recommendation 6.5.3.

4) "Tectonics Significance of the Rock Valley Fault Zone, Nevada Test Site"

This report is to be part of the forthcoming USGS circular. As such the previous discussion on the value of the circular in achieving project goals also applies here. Based on the interview with the report author, it appears that since the draft report was provided to the audit team, extensive revisions have

been and are being made. It is therefore inappropriate to discuss the draft used as a basis for the audit checklist in any detail. It is noted however, that there are Quaternary faulting characteristics such as rupture length and displacement that are not addressed in any detail; and, it is unclear exactly where or how the information presented in this report will support project goals.

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 checklists. The checklists are kept and maintained as QA Records.

5.5 Summary of Deficiencies

The audit team identified three deficiencies during the audit for which two CARs have been issued.

Synopsis of deficiencies documented as CARs are detailed below. The two CARs generated during this audit have been transmitted to you under separate letter, number YMQAD:RBC-3672 dated June 22, 1995

5.5.1 CARS

As a result of the audit, the following CARs were issued:

CAR YM-95-045

This CAR documents that the USGS report "Paleoseismic Investigations of the SCR Fault, Southeastern Yucca Mountain, Nye County, Nevada" which had been through USGS technical reviews and submitted to YMSCO for review and approval contained numerous technical errors.

CAR YM-95-046

This CAR identifies there is no documented evidence that mandatory comments to technical documents have been resolved prior to approving the documents, and that technical comments are being identified as "nonmandatory" that should have been "mandatory".

5.5.2 Deficiencies Corrected During Audit

None.

5.5.3 Follow-up of Previously Identified CARs

There was one previously issued CAR that was determined to be applicable to the scope of this audit. CAR YM-95-041 was issued just prior to this audit (re: Audit YM-ARP-95-09) regarding the improper qualification of supplier services. This condition is still unresolved; and, it was noted during that audit that a balance (scale) had been calibrated by an improperly qualified vendor being utilized in the Geologic Isotope Laboratory. This was determined to be an additional example of the deficiency previously identified in audit YM-ARP-95-09. Resolution of CAR YM-95-041 will resolve the issues identified in this audit relative to Measuring and Test Equipment (M&TE).

6.0 RECOMMENDATIONS

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

1. In discussing the errors in the SCR fault investigations report with the PI, it was noted that the emphasis on meeting milestones was provided repeatedly and that adequate time was not utilized in report preparation and review. Additionally, interviews with other PIs also consistently brought up project milestones and schedules as issues of concern in getting out deliverables. Discussions with USGS management disclosed that while project milestones and schedules are a fact of life, time management is the real problem here. Learning to work with the resources available and within time constraints, and still have a good product is the challenge. A more precise scope of what must be accomplished is required for each task. The audit team recommends that USGS identify the actions to be taken relative to time management, identifying product needs to the scientist, and customer expectations relative to the project milestones in order to improve product and processes while emphasizing that QA requirements cannot be compromised due to cost or schedule concerns.
2. It was additionally noted during the QA reviews of the SCR fault, the Bare Mountain Fault Zone, and the Paintbrush Canyon Fault Investigations reports performed by USGS that QA Review criteria are not clearly depicted in Quality Management Procedure (QMP)-3.04 that is used for reviewing technical publications. (Note: The Rock Valley fault report examined during the audit has not yet been through a QA review.) The procedure requires the QA Review to determine that the procedure has been followed. The implementation of this requirement is subject to interpretation and is ambiguous. QA however does have specific guidance depicted on a form "Manuscript QA Review Criteria" which is completed by QA during these

reviews. It is recommended that this form be incorporated into the procedure to identify the specific criteria utilized by QA during their reviews. Additionally, QA should not just determine that the Chief, Earth Science Investigations Program (ESIP) has signed the comment form, but that mandatory comments have been addressed and reconciled. See discussion in previously identified CAR YM-95-046.

3. Scientific Notebooks, technical procedures, or both are required for performing Scientific Investigations. It was noted during the audit that although personnel are working to technical procedures some analytical activities in the Isotope Geology Laboratories were documented in a laboratory notebook rather than a formal scientific notebook controlled by USGS procedure QMP-5.05. Uranium-Thorium (U/Th) Disequilibrium studies and sampling methods are performed by technical procedures, but obtaining a numerical age from the U/Th data requires some interpretation/analyses that has been documented in laboratory notebooks. There appears to be no requirement that this interpretation/analysis in the laboratory notebook will be reviewed/captured in the records system. It has been suggested that this information be documented in a scientific notebook resulting in capturing this information in the records system. The audit team examined a data package and found that at least some of this interpretation is, in fact, documented. Since the methods of interpretation are evolving, the interpretation process should be clearly documented somewhere.

Further discussion disclosed a USGS Quality Assurance Program Guidance Memorandum (No. 95.01) titled "Documenting Scientific Investigations" issued by the QA Manager and Technical Project Officer. This document clarifies at what point the use of a technical procedure or scientific notebook is required. It is recommended that this guidance is not implemented until concurred with by the Director, Office of Quality Assurance since this guidance is an interpretation of the QARD requirements and formalized into the USGS QA program; and that based on this, the USGS reassess the processes utilized in the Isotope Geology Laboratory.

4. The following issues relative to management policy are also presented for consideration and response for process improvement:
 1. Discussions were held with USGS personnel and management relative to the consistency of use and presentation of data in reports, e.g., age dating. Some reports seemingly reflect inconsistent Thermoluminescent (TL) dates. The raw dating data are presented by the labs to the PIs for use. As a result some PIs used dates that have been corrected for moisture while others present dates that have not been corrected for moisture without clearly making these distinctions in their presentations.

Another example is the inconsistency in presenting uncertainty such as two to five geologic events versus four events of which event "X" has a lower likelihood of occurrence.

2. Another issue deals with the use of "U" trend dating. While it has been recently held by the Scientific Community that this is not a reliable dating process "U," trend dating has been used to limited extent in these studies. An unresolved issue relative to continued use of this dating process was discussed. Although the use of "U" trend dating has been limited, this does not seem to be conducive to producing accurate reliable data and may require much more retrofitting of data down the road. Also, an examination of previously generated data utilizing this method of dating should be evaluated for impact.

It is recommended that USGS Management make policy decisions relative to these issues and provide them to YMQAD and YMSCO.

5. The following suggestions for improving or clarifying the specific reports evaluated is provided for management consideration. See the Section 5.4 for detailed discussions relative to these recommendations:
 1. The Paleoseismic Investigations of the SCR Fault Report contained all the information necessary for an independent reviewer to trace the conclusions back to the basic data, but inclusions of sample calculations for slip rate and recurrence interval would have added value.
 2. Relative to the Bare Mountain Fault Evaluation Report, it would be clearer if the text and trench log noted that the trench was excavated as a Q4 surface that is locally mantled with Q2 age material. The discussion of the .5 to 1.5 cm thick laminar carbonate layer and its relationship to units 2 and 4 could also be improved.
 3. Regarding the Paintbrush Canyon Fault Study, it may be advisable to either remove any discussion of Quaternary faulting north of Yucca Wash from the text or provide sufficient text and reference for a reader to understand that this issue is still to be resolved.

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

<u>Name</u>	<u>Organization/Title</u>	<u>Preaudit Meeting</u>	<u>Contacted During Audit</u>	<u>Postaudit Meeting</u>
Anderson, L.	USBR/Geologist/PI		X	
Bowen, R.P.	USGS/QAIS	X ¹	X	X
Brady, T.	USGS/ Technical Editor		X	
Burgess-Kohn, K.	USGS/SAIC/Training Coordinator	X ³	X	X
Cacaro, V.	USGS/SAIC/QAIS		X	
Chaney, T.H.	USGS/QA Manager	X ³	X	X
Chornack, M.P.	USGS/Chief Geologic Studies		X	X
Clayton, B.	USGS/Technical Editing		X	
Coates, M.M.	USGS/SAIC/Technical Editor			X
Ducret, G.L.	USGS/Associate Branch Chief			X
Gockel, D.V.	USGS/QA	X ³		
Hayes, L.R.	USGS/TPO	X ³	X	X
Kassabian, S.	USGS/FEC/QAIS			X
Keller, S.	USGS/SAIC/QAIS		X	X
Klinger, R.E.	USBR/Geologist		X	
Mahan, S.A.	USGS/Hydrologist		X	
Marden, C.	USGS/SAIC/QA	X ³		
McInroy, L.L.	USGS/SAIC/QA Verification		X	X
Miller-Corbett, C.	USGS/QAIS	X ³		
Mustard, M.H.	USGS/QA	X ³	X	X
Menges, M.C.	USGS/ Geologist/PI	X ²	X	
O'Brien, M.	USGS/QAIS			X
O'Leary, D.	USGS/Geologist/PI		X	
Paces, J.	USGS/Hydrologist		X	
Porter, D.D.	USGS/SAIC Contract Manager			X
Rodman, W.	USGS/QA (M&TE)		X	
Sinks, D.	USGS/SAIC/QA	X ³	X	
Spengler, R.W.	USGS/Geologist/PI		X	
Scheaffer, P.G.	USGS/SAIC/QAIS		X	X
Schneider, E.	USGS/Manpower Management Assistant		X	
Stuckless, J.S.	USGS/Senior Science Advisor		X	
Whiteside, A.	USGS/SAIC/QAIS	X ³	X	X
Whitney, J.	USGS/Project Chief- Seismic Hazards		X	X

ATTACHMENT 1

Personnel Contacted During the Audit

<u>Name</u>	<u>Organization/Title</u>	<u>Preaudit Meeting</u>	<u>Contacted During Audit</u>	<u>Postaudit Meeting</u>
Williams, R.S.	USGS/Chief ESIP	X ³	X	X
Ziemba, J.	USGS/SAIC/QAIS	X ¹	X	X

LEGEND:

- ESIP . Earth Science Investigations Program
- FEC . . Foothills Engineering Corporation
- PI . . . Principal Investigator
- QAIS . Quality Assurance Implementation Specialist
- SAIC . Science Application International Corporation
- TPO . . Technical Project Officer
- USBR U.S. Bureau of Reclamation
- X¹ . . . Attended both a Field (YMS) Preaudit and Denver Preaudit Meeting
- X² . . . Attended Field (YMS) Preaudit Meeting only
- X³ . . . Attended Denver Preaudit Meeting only

ATTACHMENT 2
SUMMARY TABLE OF AUDIT RESULTS

AUDIT YM-ARP-95-12 DETAIL SUMMARY

QA ELEMENT/ACTIVITIES	PROCESS STEPS	CHECKLIST DETAILS	CAR	CDA	RECOM-MENDATIONS	ADE-QUACY	COMP-LIANCE	OVER-ALL
General - Site Quaternary Faulting	Personnel are qualified, have relevant background experience and are trained	Item 1 p. 2 of 28	N	N	N	SAT	N/A	SAT
	Adequate management resources have been provided; e.g. lines of communication, personnel, equipment, feedback, realistic milestones	Items 2, 6 pp. 2, 4 of 28	N	N	Sec 6.1	SAT	N/A	
	Use of a documented, controlled system; procedures, scientific notebooks	Item 3 p. 3 of 28	N	N	Sec 6.3	SAT	N/A	
	Qualification of data and intended use.	Items 4, 5 pp. 3, 4 of 28	N	N	N	SAT	N/A	
	Special equipment-M&TE use (See previous audit YM-ARP-95-09 & CAR YM-95-041)	Items 7, 8 p. 5 of 28	YM-95-041	N	N	UNSAT	N/A	
	Data analysis/reviews/ Database	Items 9-12 pp. 6,7 of 28	YM-95-046	N	N	UNSAT	N/A	

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QA ELEMENT/ACTIVITIES	PROCESS STEPS	CHECKLIST DETAILS	CAR	CDA	RECOM-MENDATIONS	ADE-QUACY	COMP-LIANCE	OVER-ALL
Paleoseismic Investigations of the Stagecoach Road Fault, Southeastern Yucca Mountain, Nye County, Nevada	Identify product based on needs identified in SCP	Items 4, 13 pp.3, 8 of 28	N	N	Sec 6.1	SAT	N/A	UNSAT
	Identify data needs required to produce product	Items 4, 13, 16 pp.3, 8, 9 of 28	N	N	N	SAT	N/A	
	Collect data	Items 14, 16-19, 25 pp.8, 9, 10 of 28	N	N	N	SAT	N/A	
	Analyze/interpret data	Items 15, 20, 21, 23, 24, 28-31 pp.9, 11-13, 15-16 of 28	YM-95-045	N	Sec 6.3 Sec 6.4.1 Sec 6.5.1	UNSAT	N/A	
	Develop report/(product)	Items 14, 22, 26, 27, 32-35 pp.8, 12, 14, 15, 17, 18 of 28	N	N	Sec 6.4.1 Sec 6.5.1	SAT	N/A	
	Review report (technical,QA,peer)	Items 10, 26 pp.6, 14 of 28	YM-95-045, 046	N	Sec 6.2	UNSAT	N/A	
	Respond to review comment and/or incorporate comments	Items 10, 26 pp.6, 14 of 28	YM-95-046	N	Sec 6.2	UNSAT	N/A	

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QA ELEMENT/ACTIVITIES	PROCESS STEPS	CHECKLIST DETAILS	CAR	CDA	RECOM-MENDATIONS	ADE-QUACY	COMP-LIANCE	OVER-ALL
Paleoseismic Investigations of the SCR Fault (contd.)	Submit final report (products) to DOE	Items 11, 26 pp.7, 14 of 28	YM-95-045, 046	N	N	UNSAT	N/A	UNSAT
Preliminary Evaluation of the Bare Mountain Fault Zone, Tarantula Canyon, Nye County, Nevada	Identify product based on needs identified in SCP	Items 4, 36 pp. 3, 19 of 28	N	N	N	SAT	N/A	SAT
	Identify data needs required to produce product	Items 4, 36, 37 pp. 3, 19 of 28	N	N	N	SAT	N/A	
	Collect data	Items 38, 41 pp. 20-22 of 28	N	N	N	SAT	N/A	
	Analyze/interpret data	Items 38, 39, 40 pp. 20, 21 of 28	N	N	Sec 6.5.2	SAT	N/A	
	Develop report/ (product)	Items 40, 54 pp. 21, 28 of 28	N	N	N	SAT	N/A	
	Review report (technical,QA,peer)	Item 10 p. 6 of 28	YM-95-046	N	Sec 6.2	UNSAT	N/A	
	Respond to review comment and/or incorporate comments	Item 10 p. 6 of 28	YM-95-046	N	Sec 6.2	UNSAT	N/A	
	Submit final report (products) to DOE (Final report not submitted)	Item 11 p. 7 of 28	N	N	N	N/A	N/A	

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SUMMARY TABLE OF AUDIT RESULTS

QA ELEMENT/ACTIVITIES	PROCESS STEPS	CHECKLIST DETAILS	CAR	CDA	RECOM-MENDATIONS	ADE-QUACY	COMP-LIANCE	OVER-ALL
Structure of the Northern Part of the Paintbrush Canyon Fault, Yucca Mountain, Nevada	Identify product based on needs identified in SCP	Items 4, 42 pp. 3, 23 of 28	N	N	N	SAT	N/A	SAT
	Identify data needs required to produce product	Items 4, 43,45 pp. 3, 23, 24 of 28	N	N	Sec 6.5.3	SAT	N/A	
	Collect data	Items 43a, 45 pp. 23, 24 of 28	N	N	Sec 6.4.2	SAT	N.A	
	Analyze/interpret data	Items 42-46 pp. 23, 24 of 28	N	N	Sec 6.4.2 Sec 6.5.3	SAT	N/A	
	Develop report /(product)	Item 10 p. 6 of 28	N	N	Sec 6.5.3	SAT	N/A	
	Review report (technical,QA,peer)	Item 10 p. 6 of 28	YM-95-46	N	Sec 6.2	UNSAT	N/A	
	Respond to review comment and/or incorporate comments	Item 10 p. 6 of 28	YM-95-046	N	N	UNSAT	N/A	
	Submit final report (products) to DOE	Item 11 p. 7 of 28	N	N	N	N/A	N/A	

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SUMMARY TABLE OF AUDIT RESULTS

QA ELEMENT/ ACTIVITIES	PROCESS STEPS	CHECKLIST DETAILS	CAR	CDA	RECOM- MENDATIONS	ADE- QUACY	COMP- LIANCE	OVER- ALL
Tectonics Significance of the Rock Valley Fault Zone, Nevada Test Site Note: This report in process-not completed	Identify product based on needs identified in SCP	Items 4, 52 pp. 3, 27 of 28	N	N	Sec 6.1	SAT	N/A	SAT
	Identify data needs required to produce product	Item 4 p. 3 of 28	N	N	N	SAT	N/A	
	Collect data	Item 47 p. 25 of 28	N	N	N	SAT	N/A	
	Analyze/interpret data	Items 47-53 pp. 25-28 of 28	N	N	N	SAT	N/A	
	Develop report /(product)	Items 10, 49, 52 pp. 6, 26, 27 of 28	N	N	Sec 6.4.1	SAT	N/A	
	Review report (technical,QA,peer)	Item 10 p. 6 of 28	N	N	N	N/A	N/A	
	Respond to review comment and/or incorporate comments	Item 10 p. 6 of 28	N	N	N	N/A	N/A	
	Submit final report (products) to DOE	Item 11 p. 7 of 28	N	N	N	N/A	N/A	

LEGEND:

CDA . . . Corrected During Audit
 N/A . . . Not Applicable
 N None

SAT Satisfactory
 SCP Site Characterization Plan
 UNSAT Unsatisfactory