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OFFICE OF CIVILIAN
RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

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AUDIT/SURVEILLANCE
NO YMP-94-06-02

QUALITY ASSURANCE CHECKLIST

ORGANIZATION EVALUATED	[x] EXTERNAL	[x] AUDIT	PREPARED BY C.C. Wilson for R.E. HOLSTER DATE 6-9-94
USGS	[ ] INTERNAL	[ ] SURVEILLANCE	
DATES OF EVALUATION			
June 20 - 24, 1994			

CONTROLLING DOCUMENT (Title, Number, Revision)	ACTIVITY EVALUATED
Study Plans (See below)	Technical Activities

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
1	STUDY PLAN 8.3.1.4.2.1, VERTICAL AND LATERAL STRATIGRAPHIC UNITS SECTION 1.1, PAGE 1-3 The statement, "...we envision close communication and information exchange with scientists at Los Alamos in areas of potential overlap (mineralogy, petrology, and diagenesis) so that data sets collected by each group are unique and complimentary." a. In the areas of potential overlap, how is the decision made as to which group will study what topics? b. How is the data exchanged? c. If a USGS data set is revised or expanded, how is Los Alamos informed and vice-versa?		

* 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
	SECTION 2.1.1.5, PAGE 2-5		
2	Why are geo-chronological studies viewed as essential for characterizing the vertical and lateral distribution of rock units in the Yucca Mountain region, and what is the status of these studies?		
	SECTION 2.1.2.1, PAGE 2-7		
3	The discussion on this page emphasizes the need to correlate core, cuttings, borehole video camera surveys, geophysical logs, and XRF samples, what is the status of this work? Are examples available for inspection? Has this data been integrated into cross-sections or models?		
	SECTION 2.1.2.2, PAGE 2-8		
4	The statement, "...to ensure consistent interpretations, core will be re-examined by the same personnel involved with surface mapping." How is this practice documented?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	SECTION 2.2.1.1, PAGE 2-10		
5	Has the Mini-Sosie technique been tested yet? How successful was it (if used)? Have results been incorporated into cross-sections or other interpretations (if used)?		
	SECTION 2.2.1.4, PAGE 2-11		
6	Has the use of hole to surface resistivity surveys been considered at Yucca Mountain?		
	SECTION 2.2.2, PAGE 2-12		
7	How do the five profiles described and shown on Figure 2.2-1 correlate to the geophysical surveys that have been run to date?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	SECTION 2.3, PAGE 2-13		
8	What is the status of the borehole geophysical activity? How successful is the effort to quantify rock characteristics such as lithology, fracture zones, and degree of saturation?		
	SECTION 2.4, PAGE 2-16		
9	As a follow-up to Question 8 above, how successful (dependable, repeatable) is the calibration of the borehole geophysics using the petrophysical data from lab testing?		
	SECTION 2.5.1, PAGE 2-17		
10	How is the paleomagnetic data integrated with other studies, for example, the tectonic model or the 3-D geologic model?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	SECTION 3.1.1, PAGES 3-2 AND 3-3		
11	There is a discussion of strip logs and working fence diagrams, cross-sections, etc. a. What "standard scales" were used and why? b. What is the status of this work? c. Are samples from measured sections or drill holes keyed to the strip logs? d. How are these data incorporated into the geologic model and geophysical studies?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
	SECTION 3.1.1.4, PAGE 3-8		
12	What is the status of the isotopic studies designed to help characterize post-emplacement alteration.		
	TABLE 3.1-1		
13	Table 3.1-1 lists technical procedures for Activity 8.3.1.4.2.1.1. Is this a complete list? are field mapping, sampling, core logging, geophysical logging, lab analysis, etc. all incorporated in these procedures?		
	SECTION 3.2.3.1, PAGE 3-18		
14	When magnetic, gravity, and seismic surveys have been run on the same line, are structural features or lithologic contacts apparent in all the data sets? Is any one geophysical technique apparently more useful than others?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	SECTION 3.5.1, PAGE 3-27		
15	How are samples collected for magnetic studies tracked through the Sample Management Facility (SMF), and stored?		
	SECTION 4, PAGE 4-1		
16	How are the results from this study to date being factored into the hydrogeologic stratigraphy, the geochemical stratigraphy and other studies?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	STUDY PLAN 8.3.1.17.4.5, DETACHED FAULTS INTRODUCTION, PAGE 1-2		
17	It is suggested that a detachment must occur beneath Yucca Mountain at a depth of four km on the North and one km on the South. The detachment surface would then dip about 35 degrees to the North. However, extension would be at a high angle to this dip. Has this type of relationship been observed where detachments are exposed?		
	SECTION 1.1, PAGE 1-6		
18	What is the status of mapping and related activities in this study plan?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
	SECTION 2, PAGE 2-3 AND TABLE 2-1		
19	How are data integrated from other studies into the detachment fault studies? For example: a report on the C-walls suggests that the Paintbrush Fault was intercepted near the bottom of the walls. This gives the fault a dip 55 degrees to a depth of about 850 meters. Was this information used to constrain the depth of the postulated detachment below Yucca Mountain?		
	SECTIONS 2.1 AND 2.1.1, PAGES 2-3 AND 2-4		
20	It is stated that the nature of the Miocene-Paleozoic contact in the Calico Hills will be determined but no criteria for making that determination are provided. Since that work is near completion (TPR 2/94), how was the nature of the contact determined and what is the nature of the contact (tectonic or depositional)?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	SECTION 2.1.2.1, PAGE 2-4		
21	Detailed remapping of older 1:24,000 scale mapping is to be accomplished. What scale was selected and why?		
	SECTION 2.2, PAGE 2-5		
22	Is the mapping described in the Beatty-Bare Mountain area conducted by the same individual/group conducting the mapping at Calico Hills?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
	SECTION 2.2.2.3, PAGE 2-5		
23	Relative to the Bullfrog NW quad, apparently the conclusion has been made that detachment faulting has occurred here. a) What criteria were used to make that determination? b) Was Quaternary movement demonstrated?		
	SECTION 2.2.2.3, PAGES 2-5 AND 2-6		
24	Three quads are to be studied; Bullfrog NE, Bare Mountain NW, and Bare Mountain SW. How do these relate to the mapping completed in the East of Beatty Mountain quad (TPR 2/94)?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	SECTION 2.3, PAGE 2-6		
25	What is the status of the activity to evaluate the relationship between Crater Flat breccias and detachment faulting? a) Have the basaltic ash layers identified in VII-2 been dated yet? (TPR 2/94) b) How will the significance of the breccia zones be evaluated? Against what criteria?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	• RESULTS
	SECTION 2.4, PAGE 2-7		
26	Reconnaissance studies indicated that the Miocene/Paleozoic contact was tectonic and that the Miocene rocks locally form a detachment-fault-bounded upper plate in the Specter Range and Camp Desert Rock areas. Additional reconnaissance mapping has disproven the existence of a detachment fault in the Camp Desert Rock area. (TPR 2/94) a) What criteria were used to disprove the existence of the detachment fault? b) Are detailed studies still considered necessary? c) Is this mapping being conducted by the same individual/group conducting mapping in other areas discussed in the study plan?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	SECTION 2.5, PAGE 2-8		
27	What is the status of the dating studies?		
	SECTION 2.5.1, PAGE 2-9		
28	Have thermo-barometric studies been correlated with the dating studies?		
	SECTION 3.1.8, PAGE 3-3		
29	Have data from the Calico Hills mapping been integrated into the Tectonic Models and Synthesis Study yet?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
	SECTION 3.2, PAGE 3-4		
30	Have the detachment faults in the Beatty-Bare Mountain area been active during the Quaternary? How extensive is the data base supporting this conclusion?		
	SECTION 3.3, PAGE 3-6		
31	A conclusion seems to be stated i.e., that breccias were tectonically emplaced. How was this conclusion reached?		
	SECTION 4, PAGE 4-1		
32	What conclusions have been reached to date in this study and how have they been integrated into the pre- and post-closure tectonics program?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	STUDY PLAN 8.3.1.4.2.2, CHARACTERIZATION OF STRUCTURAL FEATURES IN THE SITE AREA SECTION 3.4.1, ACTIVITY 4		
33	What is the status of the data generated during the mapping of the ESF starter tunnel?		
	SECTION 3.4.1		
34	Identifies a number of features to be measured or characterized. How are these data sets compiled and stored?		
35	Study Plan identifies Technical Procedure (TP) GP-45 Procedure for ESF Geologic Mapping for this activity. What is the status of the TP?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
36	What is being used for mapping of the starter tunnel and North Ramp? Can we see the scientific notebook? Procedure GP-01 lists a number of items that should be in a scientific notebook, are they in this one? If the scientific notebook is not available, how is the data tracked and transferred to the USGS records center?		
37	What about TP GP-47, Procedure for Photogrammetric Geologic Mapping? What is the status of this TP?		
38	How is the data discussed in Section 3.4.1 correlated and integrated with data collected under Activity 2 of this study (surface-fracture network studies) and Activity 1 of Study Plan 8.3.1.4.2.1 (surface and subsurface studies of the host rock and surrounding units)?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
39	Are data sets produced by Activity 2 (surface-fracture network studies/Section 3.2.1) compatible with data sets produced by Activity 4?		
40	How are these data sets compiled and stored? How is the raw data analyzed and processed?		
41	When will the data sets be transmitted to EG&G for incorporation into the Genesis system?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	STUDY PLAN 8.3.1.8.2.1, TECTONIC EFFECTS		
42	Has any work been completed on this study beyond the completion of a draft study plan?		
43	Tectonic scenarios are a key feature of this study. How will tectonic scenarios be developed beyond what is in the SCP? How will this development be documented?		
44	One scenario in Section 2.2.1.1 is "reactivation of an existing fault, or creation of a new one, through the repository, creates a zone of elevated infiltration into the repository." How will the parameters needed to characterize this scenario be identified? How will this analysis be coordinated with performance assessment or site characterization hydrologic modeling?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
45	The draft study plan states that probabilities will be formulated and used in several of the activities within the study, for instance, Section 2.1.1.4. Will the USGS develop a formal technical procedure for the formulation and evaluation of these probabilities?		
46	Computer modeling is discussed in several sections, such as 2.3.1 and 2.3.2. How will the input parameters for these models be determined, i.e., initial and boundary conditions, physical characteristics? How will these modeling efforts be related to other project modeling efforts?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	STUDY PLAN 8.3.1.17.4.3, QUATERNARY FAULTING WITHIN 100 KM OF YUCCA MOUNTAIN INCLUDING THE WALKER LANE		
47	What is the status of the map of Quaternary Faults within 100 km of the site (Activity 2)?		
48	Section 3.2.1.1 states that existing data will be compiled for this map. What were the data sources for this map?		
49	How were data sources documented for the map?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
50	What data sets were generated? How were these data sets compiled and stored?		
51	When will the data sets be transmitted to EG&G for incorporation into Genesis?		
52	Section 3.2.1.2 states that aerial photographs will be used in this activity. How many air photos were/will be studied, in what areas?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
53	Section 3.2.1.3 states that this activity includes verification of the tectonic origin of scarps and lineaments in the field. How many entries on the map have been/will be field checked? How is this decision made?		
54	Two USGS TPs, GP-50 and GP-52, relate to the identification and interpretation of geomorphic features of possible tectonic origin. Have these procedures been used in this study?		
55	Activity 4 of this study involves field work on the Bare Mountain fault zone. How much of this work is complete?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
56	What results have you obtained relative to the age of most recent faulting, recurrence intervals and the near surface configuration of the fault zone (Section 3.4)?		
57	How will these results be incorporated into the map produced under Activity 2?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
	STUDY PLAN 8.3.1.17.4.12, TECTONIC MODELS AND SYNTHESIS		
58	What is the nature of the internal technical review of this study plan?		
59	How many people have been involved as PIs during the development of the Study Plan?		
60	On Page 1-1 of the 2/25/94 draft of this SP, there are definitions of types of tectonic models. How were these definitions developed?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
61	Pages 2-1 and 2-2 contain a discussion of modeling techniques. Apparently boundary conditions will be determined by a combination of data and assumptions. What is the source of data to be used? What assumptions will be made and how will they be supported? What documentation will be generated to document this model formulation process? Are there any preliminary results?		
62	On Page 2-7, it is stated that a list of alternative conceptual models and model elements is to be maintained. Can we see this list? How is the list updated and reviewed?		
63	On Page 2-8, there is a discussion of the formulation and evaluation of models and account for the locations, rates and sequence of eruption, and compositions of Pliocene and Quaternary volcanic rocks. How is the work being coordinated with the conceptual model development being done by LANL?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
64	Page 3-10 contains a discussion of the evaluation of disruption sequences. What is the status of this evaluation? Can we see any preliminary results? How will the results be documented and reviewed?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
	STUDY PLANS 8.3.1.4.2.3, 3-D GEOLOGIC MODELING		
65	Preliminary model developed is being done under 8.3.1.4.2.1 (from TPR 2/94). What is the status of the preliminary model?		
66	What is the status of the Study Plan 8.3.1.4.2.3?		
67	How is the fracture data from the pavement studies, the ESF mapping, and the detailed mapping along the Ghost Dance Fault being incorporated into the geologic model?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
68	How are the large format summary plots and core data from the 40 existing deep boreholes developed thus far being incorporated into the model?		
69	What was the basis for selection of the modeling software being used?		
70	Does the model distinguish between "hard" (i.e., borehole or outcrop) data and "soft" (i.e., geophysical) data?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	* RESULTS
71	How does the model develop surfaces based on data entered for each layer?		
72	How are faults defined in the model and how does the model treat pre-Tiva faults?		
73	How does the model incorporate topography and how are outcrop patterns developed from geologic mapping cross-checked with the model representation?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
74	Can model cell size be adjusted to accommodate areas of structural complexity?		
75	Can the model display multiple and/or overlapping layers, i.e., lithologic, hydrologic, and thermomechanical units is a single cross-section or block diagram?		
76	Is the model hardware/software compatible with the hardware/software that is being/will be used to model processes such as saturated and unsaturated flow, thermal response, or other processes.		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
77	How is the model updated as new data is generated? At what frequency?		
78	How are model products distributed and controlled? Are revision numbers assigned?		
79	How are lithophysal zones treated in the model? (i.e., are they bedding-parallel)?		

QUALITY ASSURANCE CHECKLIST (continuation sheet)

ITEM NO.	CHARACTERISTICS TO BE EVALUATED	REMARKS Record objective evidence reviewed, method of verification, personnel contacted	RESULTS
80	Do stratigraphic borehole picks used in the model agree with previously published values?		
81	Is any unqualified data used in the model or are all data (i.e., geophysical log picks) qualified prior to being used?		