UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 22, 2000

MEMORANDUM TO: C. William Reamer, Chief
High-Level Waste Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards

FROM: William L. Belke, Sr. On-Site Licensing Representative **/RA/**
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SUBJECT: U. S. NUCLEAR REGULATORY COMMISSION ON-SITE LICENSING REPRESENTATIVES' REPORT ON YUCCA MOUNTAIN PROJECT FOR MARCH 1, 2000 THROUGH APRIL 30, 2000

The purpose of this letter is to transmit the U.S. Nuclear Regulatory Commission (NRC) On-Site Representative's (OR's) report for the period of March 1, 2000, through April 30, 2000.

This report highlights a number of Yucca Mountain Project activities of potential interest to NRC staff. The OR's respond to requests from NRC Headquarters staff to provide various documentation and feedback related to Key Technical Issues (KTIs) and their resolution. During this reporting period, the OR's continued to observe activities associated with Yucca Mountain Site Characterization, KTIs, and auditing. The OR's also attended a number of meetings and accompanied NRC staff on visits to Yucca Mountain.

If you have any questions on this report or its enclosures, please call William L. Belke on (702) 794-5047 or Chad J. Glenn on (702) 794-5046.

Enclosures: Executive Summary
Enclosure 1: U.S. Nuclear Regulatory Commission On-Site Licensing Representatives Report
Enclosure 2: ESF/ECRB Plan View Alcove, Niche & Borehole Testing
Enclosure 3: Preliminary Layout of Thermal Test in Topopah Spring Lower Lithophysal Unit
Enclosure 4: Early Warning Drilling Program Drillhole Locations, Nye County, NV

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U. S. NUCLEAR REGULATORY COMMISSION

ON-SITE LICENSING REPRESENTATIVES REPORT

NUMBER OR-00-02

FOR THE REPORTING PERIOD OF MARCH 1, 2000 THROUGH APRIL 30, 2000

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Enclosures

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1.0 EXECUTIVE SUMMARY

Quality Assurance, Engineering and Key Technical Issues

NRC OPEN ITEM 97-2 : Data Qualification

DOE issued Corrective Action Request (CAR) LVMO 98-C-002. Verification by DOE was completed, and the CAR closed 4/10/2000 after being open for 789 days.

NRC OPEN ITEM 99-1 : Suppliers not Including Appropriate Technical or Quality Assurance Requirements in Nine Subtier Supplier's Documents.

DOE surveillance confirmed the OR observation and DOE sent a letter only to the nine affected suppliers. After this letter was sent, the OR uncovered four more suppliers with this problem. This indicates a "defect rate" in excess of 20 percent. Based on the OR recommendation, the trending program has been modified to detect supplier problems of a similar nature and discern whether the defective condition is a DOE or supplier problem. The DOE list of qualified suppliers is also not being kept current and totally accurate. DOE has initiated action to revise the system for maintaining the qualified suppliers list to assure it will be accurate and current. The above conditions are considered repetitive by the OR since they were previously documented as a deficient condition and subsequently closed by DOE as being corrected.

NRC OPEN ITEM 98-1: Length of Time to Close Deficiencies.

Deficiencies remain open in excess of two years. Procedures have been revised and a Corrective Action Board established to facilitate more timely closure of deficiencies. The OR has observed that sufficient controls and process are in place to assist closing deficiencies in a timely manner. This NRC open item is now closed after remaining open in excess of two years.

NRC OPEN ITEM 98-3: Model Deficiencies.

Determined that procedures and methodology to develop models do not meet accepted nuclear quality standards.

DOE issued CAR LVMO 98-C-010. An action plan was developed and verified by DOE as being satisfactorily implemented. This CAR was closed by DOE on 4/22/2000 after being open for 670 days.

NRC OPEN ITEM 98-4: Technical Data not Always Traceable to Origin and the Qualification Status of the Referenced Data Could not Always be Determined.

DOE issued CAR LVMO-99-001. Corrective action established a multi-step checking process for those documents that will be used in site recommendation or licensing. Closure has been scheduled/rescheduled several times. Additional corrective actions are in process and being prepared for final DOE verification.

NRC OPEN ITEM 00-01: Software

DOE issued CAR LVMO-98-C-006 on February 10, 1998, for software development and configuration systems and processes being determined to be ineffective. During a January 2000 DOE QA audit, more problems surfaced in the area of software traceability qualification. CAR-C-006, open for over 750 days, was closed in favor of issuing a new CAR LVMO-00-C-001 and four new Deficiency Reports to address the ineffectiveness of the M&O to implement the processes established. Corrective action is in process.

Exploratory Studies Facility (ESF) & NRC Key Technical Issues

ESF/Enhanced Characterization of the Repository Block (ECRB) Testing

DOE continues efforts to accelerate testing to maximize the amount of data available to support Site Recommendation (SR), with July 31, 2000, as the cut-off date to support SR.

Seepage Testing

Percolation flux and seepage testing continues at various locations in the ESF and ECRB and additional testing is planned.

Passive Hydrologic Test

Since June 1999, steel bulkheads have cut off ventilation to the ECRB beyond Station 17+63. The test objective is to allow moisture conditions in this section of the ECRB to return to ambient to determine if dripping from the rock-mass can be observed. To date, ambient conditions have not been reached. DOE plans to re-enter this area in the June 2000 time frame to install drip indicators and conduct additional work in support of this test.

Cl-36 Validation Study

Testing to verify the presence of bomb pulse Cl-36 previously detected at the Sundance Fault and other locations continues. DOE reports that preliminary Tritium and Cl-36 analyses completed, to date, have not confirmed the presence of bomb pulse Cl-36; however, additional analyses await completion. An interim report on this study is presently expected to be completed by the end of FY 2000, followed by a final report in FY 2001.

Thermal Testing

Over this period, DOE reduced the power output to heaters to maintain drift wall rock temperatures below 200° Centigrade in the Alcove 5 thermal test. DOE initiated planning for a new thermal test in the Topopah Spring lower lithophysal unit.

Nye County

Nye County continued their Phase II drilling program. Nye County officials also reported NCEWDP-4PA verification sampling results indicating no elevated radioactive contamination of groundwater at this location.

Busted Butte

Phase II tracer testing continues. DOE scientists report tracer breakthrough in collection holes from 10 and 50 ml/hr injection holes, but no breakthrough detected yet from 1 ml/hr injection boreholes. Over this period, DOE drilled 3 boreholes in the Phase II block to sample core to better define tracer pathways. Test results are to be documented in the unsaturated zone/saturated zone transport report.

EBS Testing

EBS Test #4 Drip Shield and Backfill continued over this period. Plans are underway to conduct a pre-closure ventilation test at the EBS test facility. DOE plans to conduct a third column test due to the suspected contamination of crushed tuff used in previous testing.

REPORT DETAILS

2.0 INTRODUCTION

The principal purpose of the On-Site Licensing Representative (OR) report is to alert U.S. Nuclear Regulatory Commission (NRC) staff, managers, and contractors to information on the U.S. Department of Energy (DOE) programs for site characterization, repository design, performance assessment, and environmental studies that may be of use in fulfilling NRC's role during pre-licensing consultation. The principal focus of this and future OR reports will be on DOE's programs for the Exploratory Studies Facility (ESF), surface-based testing, performance assessment, data management systems, and environmental studies. Relevant information includes new technical data, DOE's plans and schedules, and the status of activities to pursue site suitability. The OR's also participate in activities associated with resolving NRC Key Technical Issues (KTIs). In addition to communication of this information, this report may raise potential licensing concerns, or express opinions; these items represent the views of the OR's. The reporting period for this report covers March 1, 2000, through April 30, 2000.

3.0 OBJECTIVES

The function of the OR mission is to principally serve as a point of prompt informational exchange and consultation and to preliminarily identify concerns about site investigations relating to potential licensing issues. The OR's accomplish this function by communicating, consulting and identifying concerns. Communication is accomplished by exchanging information on data, plans, schedules, documents, activities and pending actions, and resolution of issues. The OR's consult with DOE scientists, engineers, and managers with input from NRC Headquarters management on NRC policy, philosophy, and regulations. The OR's focus on such issues as quality assurance (QA), design controls, data management systems, performance assessment, and KTI resolution. A principal OR role is to identify areas in site characterization and related studies, activities, or procedures that may be of interest or concern to the NRC staff.

4.0 QUALITY ASSURANCE, ENGINEERING AND NRC KEY TECHNICAL ISSUES

- The current listing and the progress of the NRC QA Open Items is listed below.

  <u>97-2 DATA QUALIFICATION</u>
  (Ref: DOE Corrective Action Request (CAR) LVMO-98-C-002 - Open 789 days).
  This Open Item was closed 4/10/2000. The NRC OR and a member of the NRC Headquarters QA staff observed the surveillance conducted for the data verification process and agree that the process is in place and appears to be acceptably implemented.

  99-1 QA/TECHNICAL REQUIREMENTS NOT INCORPORATED
  CAR-VAMO-98-C-005 was closed September 16, 1999. This CAR pertained to the M&O for failing to implement effective programs for the procurement of items and services, and for ineffective corrective actions at each of the affected organizations (National Laboratories, and USGS). Part of the requirements were for the M&O and affected organizations to include requirements for the suppliers to incorporate the appropriate DOE Quality Assurance Requirements and Description (QARD) document requirements into any subtier supplier-issued procurement document. Also required

was to ensure that all applicable QA/technical requirements were included into M&O procurement documents to suppliers. DOE OQA felt that the M&O initiated sufficient corrective actions to address this deficient condition and closed CAR VAMO-98-005 with respect to the M&O's procurement responsibilities that were passed on to the suppliers.

The OR review of supplier audit/surveillance reports generated during the period of March - October 1999, indicated there were additional problems with nine suppliers not including QA/technical requirements into their sub-tier supplier's documents. DOE OQA personnel considered this an isolated instance because it only occurred once with each supplier to sub-tier supplier procurement. Based on the audit/surveillance findings, DOE OQA considered the actual findings to be insignificant and did not warrant removal of the suppliers from the Qualified Supplier's List (QSL) and that overall, the DOE QA supplier audit program is working. Although supplier audits/surveillance deficiencies are entered into the trending program data base for tracking purposes only, these deficiencies are not trended. The trending program only applies to the deficiencies affecting and pertaining to the OCRWM QA program and not to its suppliers.

Failure to incorporate appropriate QA/technical requirements into subtier supplier procurement documents appears to be a problem area with several of the OCRWM qualified suppliers that require attention and improved communication with all qualified suppliers. The NRC OR does not consider this issue to be insignificant and recommended in October 1999, that DOE issue a strong generic letter directing all suppliers to fully comply with the DOE QARD requirements (analogous to "lessons learned"). This would include special attention to ensure appropriate QA/technical requirements are included into suppliers and subtier suppliers procurement documents. It is the OR's understanding that a letter was issued about three months later only to the nine suppliers identified in the September/October 1999, OR report and not the entire population listed on the QSL as the OR recommended to DOE OQA Management.

During this past OR reporting period, the OR reviewed the supplier audit/surveillance reports for the period of 11/99-3/00. The results of this review revealed there were four more instances where the DOE auditors uncovered deficiencies, whereby suppliers were not incorporating applicable QA/technical requirements into procurement documents. From the OR's review of the supplier DOE audits/surveillances, the amount of suppliers encountering this problem totals up to 13 to date. Given there are about 60 suppliers on the QSL this equals about a 20 percent defect rate. The OR considers this condition to be unacceptable because it has possible impacts on procurement efforts directed toward potential Site Recommendation (SR) or License Application (LA). Corrective action has not been effectively initiated and implemented for this condition. Consequently, this issue will continue to be carried as NRC Open Item 99-1.

In OR Report 99-05 dated November 3, 1999, it was recommended that the DOE trending program should have the capability to notify appropriate management when similar notable deficiencies are observed at individual suppliers. When similar conditions are detected, all suppliers and subtier suppliers should be notified and alerted of these conditions. The trending program has been modified to detect conditions of a similar nature and narrow these issues down to whether they appear to be a DOE or a supplier problem. Section 7.2.4, "Supplier Performance Evaluation," of Section 7, "Control of Purchased Items and Services," of the QARD, Revision 9, requires that measures be established to interface with and verify supplier's performance. One of

these measures include establishing an understanding between the purchaser and supplier. Subsection f of Subsection 18.2.2, “Scheduling of Audits,” in Section 18 “Audits” of the QARD, Revision 9, requires that an annual performance evaluation shall be performed on each supplier to determine the need to schedule audits and the evaluation shall be documented and based on several factors including the results of previous source evaluations, audits, management assessments, receiving inspections audits from other sources etc. Therefore, it appears that it is necessary to track and even trend the performance of vendors in order to determine if the audit or surveillance frequency is needed to be increased. It may be appropriate to perform a vendor surveillance to specifically review the procurement activities of certain vendors (especially if there is a trend or evidence of recurring problems). What has not been modified is that when a recurring issue appears to be surfacing at several suppliers, there is no notification to all suppliers to be aware of this condition. It is again recommended that this notification process possibly be put in the form of an “information type notice,” “lessons learned,” etc.

In another supplier-related review, the OR compared the past six months of DOE supplier audit/surveillance reports versus the QSL dated 3/7/00, which indicated that the QSL is not being maintained current and totally accurate. DOE OQA initiated Deficiency Report (DR) OQA-00-D-O14 on 11/10/99, noting that the QSL was not being maintained to accurately reflect the contents of supplier/evaluations/documents. This DR was closed on 3/10/00. The reference date of the QSL for this DR was 9/28/99. Part of the corrective action to close this deficiency was to verify all QSL input after 11/11/99 and assure that the data on the QSL is complete and accurate.

The OR review of the QSL dated 3/7/00 generated questions pertaining to: 1) suppliers recently audited were not on the QSL; 2) suppliers noted with several notable deficient areas continue to remain on the QSL with no restrictions; 3) suppliers audited with no deficient areas were recommended to be placed on QSL and are not on QSL; and 4) potential suppliers were recommended for placement on QSL pending resolution of substantive findings. These conditions are repetitive of the conditions identified in the above closed DR OQA-00-D-014 and indicate ineffective corrective action.

CAR LVMO-98-C-002 was issued 2/11/98 and closed 4/10/00. One of the deficient conditions identified in this CAR was that suppliers were placed on approved suppliers’ lists without having a QA program that met the QARD requirements and/or the requirements were not sufficient for the proposed scope of work. Another element of this CAR was the removal of suppliers from the approved suppliers lists and subsequent use for analytical services without being re-evaluated or re-qualified.

The QSL matter was discussed with DOE OQA and DOE OQA representatives. The results of this discussion revealed that the OR review was based on the review of the supplier audit/surveillance reports without reviewing the Supplier Evaluation Report (SER). The purpose of the supplier audit/survey report is to document and report the performance or evaluation of the supplier in meeting procurement and QA requirements. The SER documents the evaluation as to whether the supplier is qualified to perform items or services subject to procurement requirements. Consequently, after the SER review, the questions raised by the OR on the QSL were all documented satisfactorily.

However, DOE OQA initiated action to revise the QSL methodology to make it more user friendly and easier to control changes. The QSL, currently on a VAX system, will now be enhanced and placed on Lotus Notes. The two systems will be run concurrently for a few weeks to assure the reliability of the Lotus Notes system, then the VAX system will be discontinued. The SER will now be retrievable through the Lotus Notes in conjunction with the applicable audit/surveillance report. A complete detailed description of this revision will be provided in the next OR Report. The OR concludes from the preliminary discussions on this revision that it will provide a significant improvement over the current QSL and reduce the likelihood for errors.

98-1 LENGTH OF TIME TO CLOSE DEFICIENCIES (Open since Jan/Feb 1998)
The OR review of the open and closed deficiency documents indicated many deficiencies remained open in excess of one year. This was originally reported in the OR Report for January/February 1998. A CAR similar in nature was issued by DOE in 1994 for this same type of deficiency (CAR-LVMO-94-C-010). This did not meet the full intent of Criterion XVI of Appendix B to 10 CFR Part 50 for prompt identification and closeout of deficiencies.

The Yucca Mountain Site Characterization Office Corrective Action Board (CAB) was established in January 1999, and has had a positive influence in expediting closing deficiencies in a more timely manner relative to their respective order of importance. Also, the performance/deficiency reporting procedure (AP-16.1Q) and the corrective action and stop work procedure (AP-16.2Q) were revised and consolidated into AP-16.1, “Management of Conditions Adverse to Quality.” On June 1, 1999, all deficiencies open in excess of one year were elevated to the DOE OCRWM Director for extended processing approval and an agreed upon closure date. However, several of these deficiencies were again extended since the agreed upon extension dates for completion could not be met.

The process for identification and issuance of deficiencies has been revised to include an early identification of pending deficiencies to the Quality Systems (QS) representatives. The QS representatives will use this pending information to help the M&O establish the appropriate responsible Directors and responsible managers for a pending deficiency. The QS in turn inputs this information to the database for the pending deficiency to be used by OQA in issuance of the deficiency. This improved method of communications should assist the M&O towards continued improvement in early resolution of corrective action.

The April 30, 2000, DOE trending deficiency list noted there were 41 open deficiencies with only one remaining open in excess of one year. Based on the actions noted above, the OR has observed that sufficient controls and process are in place to assist closing deficiencies in a timely manner. Therefore, NRC Open Item 98-1 is closed. The NRC OR will continue to observe and monitor the progress for this corrective action.

98-3 MODEL DEFICIENCIES (Open 670 days)
(Ref: CAR-LVMO-98-C-010)
The M&O line organization’s two vertical slice reviews (Site-Scale Unsaturated Zone Flow Model and the Total System Performance - 1995 for Waste Form Degradation and

Solubility Limits reports) in late 1997 and early 1998, concluded that procedures used to develop and document these models do not generally meet accepted nuclear QA standards.

An implementation action plan was developed by the line organization resulting from the issuance of CAR LVMO-98-C-010. The intent of this plan was to identify the models being developed or which are in use, and the pertinent output of the data in these models. The progress/improvements resulting from this action plan were originally scheduled for completion by October 29, 1999. The Verification Team evaluated the response/plan and determined more information was needed to verify effective implementation. The anticipated verification date was rescheduled for late January 2000, and then changed to April 2000. DOE OQA verified the corrective actions were performed and felt significant progress had been made to establish a program for models and implementation of corrective actions. DOE OQA closed this CAR on 4/22/00. Based on the DOE OQA verification, NRC Open Item 98-3 is also closed. The NRC OR will continue to observe and monitor the progress for this corrective action.

98-4 TRACEABILITY
(Ref: CAR LVMO-99-C-001)
As a result of the October 1998, DOE performance-based audit of the M&O, CAR LVMO-99-C-001 was issued because technical data referenced in Viability Assessment technical documents were not traceable to the origin, and the qualification status of referenced data could not always be determined.

The corrective action established a multi-step checking process to review and evaluate a given list of documents to be used in support of SR/LA. Those documents identified will be corrected or replaced as applicable. Documents identified that will not support SR/LA will have no remedial action taken and justification for this decision will be documented. This CAR was scheduled for completion by December 30, 1999. The response to this CAR was evaluated and found to be unsatisfactory. AP-3-10Q, “Analyses and Models” requires additional revision to satisfactorily close the CAR. The anticipated verification date rescheduled for 1/24/00 has been changed to late March 2000. This date has been extended again and the M&O is presently in process of completing additional corrective actions in preparation for DOE verification.

SOFTWARE
On February 10, 1998, CAR LVMO-98-C-006 (open 750 days) was initiated for software development and configuration systems and processes being determined to be ineffective. This CAR identified deficiencies related to the M&O software programs that were developed and used for quality-related activities throughout the project without the required software life cycle baseline controls. The CAR also identified that some of the M&O software programs had not been properly identified or placed under the necessary configuration management program.

During the January 24-28, 2000, DOE QA audit of the Unsaturated Zone Flow and Transport Model Report, more problems in the area of software traceability and qualifications surfaced. The audit determined that the control, qualification, and application of software through the implementation of procedures AP-SI.1Q (Software

Management) and AP-3.10Q (Analyses and Models) was ineffective. This is particularly important because AP-SI.1Q was previously identified as the principal measure to prevent recurrence. DOE OQA Management therefore determined that the process established for software management is ineffective. The DOE OQA staff completed its verification of the corrective actions for CAR LVMO-98-C-006 and determined that all actions were completed. However, the M&O failed to effectively implement APSI-1Q which was committed to as an action to prevent recurrence of CAR LVMO-98-C-006. The continuing implementation deficiencies were incorporated into four deficiency reports and CAR LVMO-00-C-001 was issued. Based on these actions, CAR LVMO-98-006 was closed.

NRC QA AUDIT OBSERVER INQUIRES

The OR Office has been tracking the NRC QA Audit Observer Inquiries issued during the QA PMR/AMR audits observed recently. Some of these QA Audit Inquiries have been open as long as six months, which should not be necessary. This matter was referred to the OQA QA Director who formally transmitted the completed inquiries to the NRC staff in an April 4, 2000, letter from R. Clark to C. W. Reamer. The OQA QA Director has also requested appropriate M&O management in the future to expedite responses to NRC audit observer inquiries.

5.0 EXPLORATORY STUDIES FACILITIES (ESF), AND NRC KEY TECHNICAL ISSUES

Enhanced Characterization of the Repository Block (ECRB)

DOE continues to accelerate their ECRB construction and testing activities to maximize the amount of data available to support DOE Total System Performance Assessment (TSPA) - Site Recommendation Rev.1. The proposed cut off date for data to be considered for this revision is July 31, 2000. Enclosure 2 provides ESF and ECRB test locations.

The excavation of the ECRB, completed on October 13, 1998, allows the collection of scientific and engineering data in stratigraphic units that constitute over two-thirds of the potential repository horizon. Temperature, relative humidity, barometric pressure, air flow velocity, rock mass moisture, and construction monitoring data continues to be collected.

Passive Hydrologic Test (17+63 - 28+23):

Since June 1999, two sections of the ECRB have been isolated from the rest of the underground facility by the construction of sealed bulkheads. These bulkheads are located at Stations 17+63 and 25+03. No forced ventilation occurs beyond the bulkheads, except during brief entries to collect data and perform maintenance. This is a passive test designed to allow the isolated parts of the ECRB to return to ambient (pre-construction) moisture and temperature conditions to determine if dripping from the rock-mass can be observed. Hundreds of heat dissipation probes were previously placed in the tunnel walls at depths of up to 2 meters. Test probes in this sealed off area that had previously shown evidence of rock drying under ventilation now show evidence of rewetting. DOE scientists state that moisture conditions in this section of the ECRB have not fully re-equilibrated.

The isolated parts of the ECRB are re-entered about every two months to do maintenance on a tunnel boring machine and to obtain neutron moisture logs through boreholes in the tunnel walls. This re-entry results in several days of ventilation, but the effects on long-term rewetting of tunnel walls appear small. Ventilation lowers the relative humidity in the ECRB to about 25 percent. Resealing the bulkheads causes the relative humidity to rise to about 85 percent in just several days, and it rises gradually over the following weeks to 96 percent or greater.

OR report Number OR-00-01 noted that DOE scientists observed condensate and mold when the bulkheads were last opened. Over this period, DOE reopened the first bulkhead to collect air samples to determine the level of mold in the air. In the June 2000 time frame, DOE plans to re-enter this area to perform additional work in support of this test. This work includes: 1) the installation of drip indicators (pH treated cloth) and additional instrumentation for moisture monitoring; 2) the installation of a third bulkhead between the TBM and Solitario Canyon Fault; 3) further characterization of organic material (mold); and 4) the rewiring of lights in this section of the ECRB. DOE currently plans to continue this test through FY 2000, and perhaps longer.

Niche #5 (16+20):
This niche is being constructed at station 16+20 to conduct seepage testing in the Topopah Spring lower lithophysal zone. Over two-thirds of the potential repository is planned to be located in this rock unit. A 14 meter access drift was previously excavated to initiate testing. This niche will eventually be excavated to a total depth of approximately 30 meters. A final series of radial boreholes will be drilled from the completed niche. Niche walls and boreholes will be instrumented with moisture monitoring equipment and a bulkhead constructed at the entrance of this niche. Test results will feed the unsaturated zone flow and transport process model report.

Over this reporting period, DOE scientists completed air permeability and liquid release testing from radial boreholes drilled in the rear face of the 14 meter access drift to determine pre and post excavation effects. Color dyes used in liquid release testing will facilitate the tracking of flow paths as the niche is excavated to total depth.

Alcove 8 (8+00):
This alcove is being constructed to conduct seepage testing from the Topopah Spring upper lithophysal zone to the underlying Topopah Spring Middle nonlithophysal zone. A series of boreholes will be drilled downward from this alcove for moisture monitoring. Niche #3, previously constructed in the Topopah Spring Middle nonlithophysal zone, is situated directly below this alcove and will be used in this infiltration test. Four boreholes have been drilled upward from Niche #3. An infiltration system will be constructed on the invert in Alcove 8 and traced water applied to the invert at a measured rate. Boreholes in Alcove 8 and Niche #3 will be used to monitor changes in moisture content and other properties of the rock-mass. DOE scientists plan on monitoring these boreholes using ground penetrating radar, neutron logging, acoustic tomography, and electrical resistivity tomography. A bulkhead will be constructed at the entrance of this alcove. Seepage testing is expected to start in the May 2000 time frame. Test results will feed near field and unsaturated zone flow and transport process model reports.

Over this period, the excavation of this alcove was completed to a depth of approximately 32 meters. On March 6, 2000, DOE detected a wet spot in Niche 3 coincident with this excavation. A catchment device was installed in Niche 3 to collect drips should they occur. On March 23, 2000, the OR viewed Niche 3 and noted that the wet spot had enlarged, and water was visible on the rear portion of the crown and back face of the niche. Water on the crown appeared to follow the contour of the crown and rear face of this niche. At the time, the OR noted no evidence of water in the collection system or on the floor of the invert. To date, DOE reports that no water has been collected in the catchment system. DOE is assembling the water use records for the excavation in Alcove 8 to estimate the seepage rate from Alcove 8 to Niche 3. Geologic mapping over this period identified a fracture on the floor of Alcove 8 that corresponds to a mapped fracture in the crown of Niche 3. DOE scientists believe that this fracture likely served as the primary pathway for seepage into Niche 3.

Based on the OR understanding, baseline measurements from boreholes drilled in Niche 3 were not completed before the detection of seepage in this niche. In the OR's view, DOE should consider any lessons learned from this event to ensure that, in the future, baseline data collection is completed before the test bed is perturbed by construction or other activities.

Systematic Boreholes:
Project scientists plan to conduct a systematic hydrological investigation of fracture flow and transport properties in the cross-drift. DOE plans to drill a number of boreholes in the Topopah Spring lower lithophysal unit between Stations 14+44 and 17+63. The boreholes will be used for air permeability and liquid release testing for percolation and seepage testing. Test results will feed the near-field and unsaturated zone flow and transport process model reports.

Over this period, DOE completed drilling the first set of four boreholes (two horizontal, one near-vertical, and one inclined borehole) at approximately Station 17+55. A single borehole was also completed at Station 17+26.

Cross Drift Drainage Benches:
Six drainage benches will be excavated for this testing. These 1 meter X 1 meter X 0.5 meter high benches will be used to conduct infiltration tests. A constant head infiltrometer (approx 60 centimeters in diameter) is mounted on the surface of each bench. Traced water is applied to the surface of these benches to determine the infiltration rate and flow path of water through the rock mass.

Over this period, testing continued at drainage benches located at Stations 17+35 and 15+20. Two additional drainage benches have been constructed at Stations 11+15 and 13+00.

Cross Drift Thermal Test (CDTT):
DOE is planning a thermal test in the Topopah Spring Lower lithophysal unit at ECRB Station 16+95. Enclosure 2 provides a preliminary layout of this test. A CDTT plan is expected to be completed in July 2000. According to DOE, the test facility may be constructed by December 2000, and heating initiated by April 2001. The heating and

cooling phase will require approximately 19 months followed by post-test characterization. DOE expects to have preliminary test results by March 2002, and a final report in FY 2003.

Exploratory Studies Facility (ESF) Testing

Moisture and post-construction monitoring continue in the ESF. DOE scientists are proceeding with a study to validate the presence of bomb-pulse chlorine-36 at two locations in the ESF. DOE scientists completed the collection of approximately 50 samples in the vicinity of the Drill Hole Wash Fault and the Sundance Fault where anomalously high concentrations of chlorine-36 were detected in a previous study. These samples are being analyzed for chlorine-36, tritium, technetium-99, and supplemented by analyses of uranium, thorium, iodide-129 and radium isotopes. An interim report is presently expected to be completed by the end of FY 2000, followed by a final report in FY 2001.

Alcove 1:
The second phase of the artificial infiltration test continued over this reporting period. Since the start of this phase of testing on February 19, 1999, through April 17, 2000, approximately 525,858 liters (138,917 gallons) of water have been applied at the surface and approximately 94,230 liters (24,893 gallons) collected in Alcove 1. Initial breakthrough of traced water occurred on March 6, 1999.

Since October 15, 1999, DOE scientists have been conducting their final infiltration experiment at Alcove 1. Lithium bromide traced water (280 parts per million LiBr) was applied at the surface, at a rate of approximately two centimeters per day, to determine the travel time required for this tracer to seep into Alcove 1. DOE terminated the application of this tracer on January 31, 2000, but continues to apply construction water at the surface to monitor the tail-off of tracer concentration in Alcove 1. Project scientists believe breakthrough of this tracer occurred on approximately November 25, 1999. The concentration of lithium bromide traced water collected in Alcove 1 is presently approximately 100 parts per million and scientists plan to continue monitoring the tail-off of concentration in traced water. According to DOE scientists, preliminary qualitative analysis of this experiment indicates that when the rock-mass is saturated and steady-state flow conditions are established, the travel time from the land surface to the alcove (distance of 32 meters) is approximately three to four weeks. Data from this testing will serve as input to a report on unsaturated zone model validation. This testing is expected to be completed in August 2000.

Alcove 2:
This alcove serves as a Yucca Mountain display center for ESF visitors. Therefore, there is no further testing conducted in this alcove.

Alcoves 3 and 4:
Over this reporting period, DOE scientists installed moisture monitoring instrumentation (tensiometers) in two 30 meter deep boreholes in the Paintbrush nonwelded tuff unit. A downward looking borehole from Alcove 3 captures the upper section of this unit, and an upward looking borehole from Alcove 4 captures the lower section of this unit. Together, this instrumentation is expected to help develop a better understanding of the moisture characteristics of the Paintbrush nonwelded tuff unit.

Alcove 5 (Thermal Testing Facility Access/Observation Drift, Connecting Drift, and Heated Drift):
DOE initiated the heating phase of this test on December 3, 1997. The four-year heatup phase will be followed by a four-year cool-down phase. Heat generated by nine electrical floor heaters and 50 electrical wing heaters simulate heat from emplaced waste. This test is designed to heat approximately 15,000 cubic meters of rock in the proposed repository horizon to 100° Centigrade (212° Fahrenheit) or greater to investigate coupled thermal-hydrologic-mechanical-chemical processes. These processes are monitored by approximately four thousand sensors positioned in 147 radial boreholes around the heated drift. A data collection system records measurements from these sensors.

On April 26, 2000, sensors in the heated drift recorded the following preliminary temperatures: canister temperature of 197.2° Centigrade (387° Fahrenheit), rock-mass surface temperature of 192.8° Centigrade (379 Fahrenheit), and air temperature of 197.2° Centigrade (387° Fahrenheit).

Over this period, DOE scientists lowered the power output to heaters to maintain drift wall temperatures below 200° Centigrade (392° Fahrenheit). Water samples were collected from hydrology holes over this period. The next DOE sponsored thermal test workshop is scheduled for May 11, 2000 at Lawrence Livermore National Laboratory.

Alcove 6 (Northern Ghost Dance Fault Alcove):
Over this reporting period, there was no new testing conducted in this alcove.

Alcove 7 (Southern Ghost Dance Fault Alcove):
Excavation of this alcove cut the Ghost Dance Fault at station 1+67. Since November 1997, water-potential data has been collected from 51 probes in the rock mass surrounding Alcove 7, and 8 surface-based probes in soil within and adjacent to the Ghost Dance Fault zone. This instrumentation is designed to measure natural infiltration at the surface and changes in temperature, pressure, and moisture conditions in the rock-mass around this alcove. DOE scientists report that moisture monitoring instruments indicate the rock-mass has rewetted to preconstruction levels. This alcove remained closed over this period.

Niche #1 (35+66), Niche #2 (36+50), Niche #3 (31+07), and Niche #4 (47+87):
These niches have been excavated and bulkheads constructed at the entrance of each niche. In 1998, investigators completed drift seepage threshold testing in Niche #2. In 1999, DOE scientists completed water release tests at Niche #3. No further work is planned for Niches #1, #2. Niche #3 will be used to monitor seepage testing in Alcove 8. Over this period, seepage testing continued in Niche #4.

Fluid Inclusion Study:
University of Nevada Las Vegas (UNLV) scientists are proceeding with a study to date the age of fluid inclusions found in calcite at Yucca Mountain. The characterization of over 150 samples collected from the ESF and ECRB continues to better understand the development of secondary minerals and spatial distribution of fluid inclusions. UNLV scientists plan on conducting their next quarterly status meeting of this study over the week of June 19, 2000. This study is currently expected to be completed in the Spring 2001 time frame.

Laser Strainmeter Test:
Under a cooperative agreement with the YMSCO, the University of California, San Diego will install and monitor a long-baseline strainmeter (LSM) in the ESF. The LSM experiment will supplement geodetic Global Positioning System surveys conducted at five sites in the Yucca Mountain area from 1991 to 1997, which indicated higher crustal elongation rates (strain rates) than those indicated by the volcanic and tectonic history of the region.

The general test description consists of the installation and operation of the LSM along the South Ramp of the ESF. The setup consists of measuring the distance between two end monuments using a laser. The laser path will be through a vacuum tube approximately 500 meters long on the right rib of the South Ramp between Stantions 65+00 and 70+00. The four instrument boreholes have been drilled. Installation of instrumentation and initial data collection is expected to start over the Summer of 2000.

Surface-Based Testing

Nye County Drilling and Testing:
The second phase of the Nye County drilling and testing program continued over this period. Planned Phase II wells include the following: NC-EWDP-4PA and 4PB, NCEWDP-7S, NC-EWDP-12D, NC-EWDP-15D, NC-EWDP-22S, NC-EWDP-23S, NCEWDP-3DB, NC-EWDP-2DB, NC-EWDP-5SB, and NC-EWDP-19 well complex. Enclosure 3 shows the location of these wells.

On February 29, 2000, Nye County reported that preliminary geochemical analyses of a water sample from NC-EWDP-4PA yielded higher than background levels of radioactivity. On March 2, 2000, Nye County resampled this well and independent samples were also collected by DOE and State of Nevada, Department of Health. The Nye County and DOE geochemical analyses of water samples collected on March 2, 2000 yielded radioactivity levels below the drinking water standard (10 picoCurie/liter gross alpha, 15 picoCurie/liter gross beta). In an April 5, 2000, meeting of the Community Advisory Board (CAB) for Nevada Test Site Programs, Nye County's Manager of the Department of Natural Resources reported that the results of their verification sampling indicate no elevated radioactivity in groundwater at this location. In this same meeting, a representative of the State of Nevada Division of Environmental Protection commented that it was his understanding that the State's water analyses corroborated the results of Nye County's verification sampling. The OR has requested a copy of the State's water analyses.

Characterization of Near Surface Velocity:
DOE plans to initiate a study to characterize the near surface velocity structure of Yucca Mountain. The start of this work has been delayed, but is presently expected to start in the June 2000 time frame. This study will be conducted through the Nevada university system. Scientists plan on using surface wave recordings generated by explosions in three boreholes along the crest of Yucca Mountain to test the near surface velocity structure. This data will be used as input to the design of surface facilities for a potential repository.

Waste Handling Building Geotechnical Investigation:
DOE plans to conduct a geotechnical investigation at the Yucca Mountain North Portal area to collect data for the design of a waste handling building for a potential repository. This activity will involve drilling a series of boreholes and excavating trenches/test pits to further characterize this area. Geophysical data will be collected to obtain shear wave and compression wave velocities. This investigation is scheduled to start in the June 2000 time frame.

Pneumatic Testing:
Pneumatic data recording and gas sampling continues at UZ-4/5, NRG-7a, and SD-7; however, DOE is presently considering closing their pneumatic monitoring in FY 2000. Nye County is recording pneumatic data at ONC-1.

Busted Butte Unsaturated Zone Transport Test:
The planned hydrologic and tracer testing at Busted Butte is designed to provide data to help model the travel of radionuclides in the unsaturated zone under the proposed repository. This underground facility includes a 72.5 meter main drift and 19 meter test alcove. The test is fielded in the base of the Topopah Spring non-to-partly-welded vitric sub-zones and the top of the Calico Hills Formation. Phase I tracer testing was completed in 1998.

The Phase II tracer injection continues in a separate 10 X 10 X 6 meter block of rock exposed on two sides in this underground facility. Tracer injection started on July 23, 1998, and DOE plans to continue injecting through FY 2000. The Phase II test includes eight injection and twelve collection boreholes ranging from 7-10 meters deep. Each injection borehole is equipped with 10 injection ports representing a significant scale up from the Phase I test. Nonradioactive tracers are injected at rates of 1, 10, and 50 ml/hr simulating infiltration rates of 30, 380, and 1550 mm/yr. Borehole geophysics and moisture collection pads are used to monitor the migration of tracers. To date, DOE scientists have detected tracer breakthrough at collection boreholes from the 10 and 50 ml/hr injection boreholes, but no breakthrough has been detected from the 1 ml/hr injection boreholes. Results of this testing will be documented in a report on unsaturated zone/saturated zone transport properties, which is expected to be completed in May 2000. Over this period, DOE drilled three 10 meter deep coreholes for rock analyses to better define tracer migration in the test block. Analytical results of the cores will be used to determine the date for terminating tracer injection and initiating post test characterization.

In December 1999, two one-cubic meter blocks of the Calico Hills Formation (cut from the Busted Butte test facility) were transported to Canada by Atomic Energy of Canada, LTD., (AECL), for use in radionuclide transport testing at the AECL laboratory. Preparations are underway to initiate radionuclide transport testing on these blocks. Over this period, AECL started preliminary testing on a smaller block of tuff before initiating testing on the two larger blocks.

Engineered Barrier System (EBS) Testing:
The Engineered Barrier System Operations (EBSO) Office of the Yucca Mountain Project continues to perform EBS testing. The EBS tests are performed in a Pilot Scale Test Facility

located in North Las Vegas. USGS also supports the EBS tests providing hydrologic properties of the test materials and instruments such as heat dissipation probes, lysimeters and data loggers. Test results feed the EBS degradation and transport process model report.

Pilot Scale Testing

EBS Test #4, Drip Shield and Backfill:
This test, which started in December 1999, continued over this period. The primary objective of this test is to simulate the movement of moisture (water dripping from the roof of the emplacement drift) on the backfill and how it moves through the backfill and is removed by the natural fractures in the repository emplacement drifts. For this test, the surrogate EBS system consists of a carbon steel cell (1.4 meters in diameters and 4 meters long). The test cell simulates the 5.5 meter diameter emplacement drift. Other components of the test include: a stainless steel drip shield, a carbon steel waste package, welded tuff invert, and Overton sand as backfill. The simulated waste package is 39 centimeters in diameter and 3.93 meters long. The decay heat from high-level waste is simulated by a 5 kW rod heater. Strip heaters on the exterior wall of the test cell control cell wall (drift wall) temperatures.

On February 17, 2000, DOE scientists started dripping J-13 well water in the test cell at a rate of one liter per hour. The dripping water reached the invert shortly thereafter and continues to be drawn out of the test cell by lysimeters. As of April 14th, the test is approaching steady state. DOE scientists report that the space below the drip shield is dry as the water continues to be diverted by the drip shield. The drip system requires much more maintenance than was expected due to clogging of particulates in J-13 water in valves and drip tubing.

EBS Test #5, Breached Waste Package:
Test #5 is presently on hold due to funding constraints. This test was originally intended to investigate the pooling of water in a breached waste package and the environment at which pooling might occur in the waste package.

Pre-closure Ventilation Test:
Plans are underway to conduct a pre-closure ventilation test in the EBS test facility.

Column Testing:
In December 1999, DOE started column testing using crushed tuff. This testing is designed to replicate a previously reported test by Rimstidt (Rimstidt and Williamson 1991). The test objectives include:

• Comparing Thermal Hydrologic Coupled (THC) effects in different materials (e.g., crushed tuff, quartz sand, or limestone); characterizing the THC processes that could affect drip shield performance, particularly the magnitude of permeability reduction, the nature of minerals produced at or near the drip shield surface, and chemical fractionation.
• Analyze the composition of fluid that enters the backfill after heating and remobilizes the precipitates.

• Generate data for validating THC predictive models in support of the EBS PMR, Rev. 01.

To date, two column tests have been completed. For Column Test #1, the column was fabricated from polycarbonate tubing. This column developed leaks at some of the sampling ports and at the base near the heater. The bottom of the column was etched and could not be resealed. Column Test #2 started on January 5, 2000. This column was fabricated from underground PVC pipe. This test was terminated after 22 days of operation. Liquid and altered welded tuff samples were extracted from Column Test # 1 and #2. The laboratory analysis of the welded tuff used for the test revealed that it contained materials not native to Yucca Mountain. DOE believes that during the crushing operations foreign material contaminated the welded tuff.

Since the crushed tuff was found to be contaminated, DOE is conducting a third column test. The column for this test is fabricated from stainless steel, and the annulus is coated with Teflon. The welded tuff was acquired from the ECRB and crushed at DOE's test support facility in North, Las Vegas. Column Test #3 started on April 17th, and is expected to run for 90 days.

6.0 GENERAL

1. Appendix 7 Interactions

On April 27, 2000, a representative of the NRC Division of Waste Management visited well locations for the Nye County Early Warning Drilling Program and the Busted Butte Test Facility.

2. Other

On April 5, 2000, an OR toured underground facilities at Yucca Mountain with representatives of U.S. Technical Review Board, DOE, and DOE/M&O scientists. This group viewed construction and testing activities in Alcoves 1, 4, 5, 6, 8, and Niche 2. DOE scientists discussed the testing at these locations. Highlights from these discussions include the following:

• In Alcove 1, while fractures dominate fluid flow, tracer testing provides evidence for a small component of matrix diffusion. The evidence for matrix diffusion is based on 1) breakthrough of water in Alcove 1 before the breakthrough of lithium bromide tracer, and 2) reduced tracer concentration in water collected in Alcove 1.

• Alcove 4 Fracture-Matrix Conductivity test in Paintbrush nonwelded tuff: In October 98, approximately 200 liters of water were released from a borehole into a near vertical fault exposed on the rear face of this alcove to determine if water would travel down the fault and drip into collection trays installed in a slot cut several meters below the water release point. No wetting or dripping was detected in the slot cut. This test was repeated a year later and a wet spot was detected in the slot cut, but no dripping water was observed. According to DOE scientists, an important observation from this testing is that as the test progressed, the flow rate of released water decreased. This decrease in flow rate may be due to a possible decrease in permeability of the rock-mass in the test

bed as water was released. A thin clay layer noted between the injection borehole and the slot cut may divert/impede downward flow of water. Results of this testing are expected to be documented in the revision to the AMR on In-situ Field Testing of Unsaturated Zone Processes.

• Alcove 6 Fracture-Matrix Conductivity test in Topopah Spring middle nonlithophysial unit: Water release testing indicates that 60-80% of water released in a borehole at this location flowed through fractures and was collected in a slot cut below the injection borehole. The remaining fraction of water was either retained in fractures or imbibed in matrix.

• Niche 2 - based on past testing, the seepage threshold at this location is estimated to be approximately 200 mm per year.

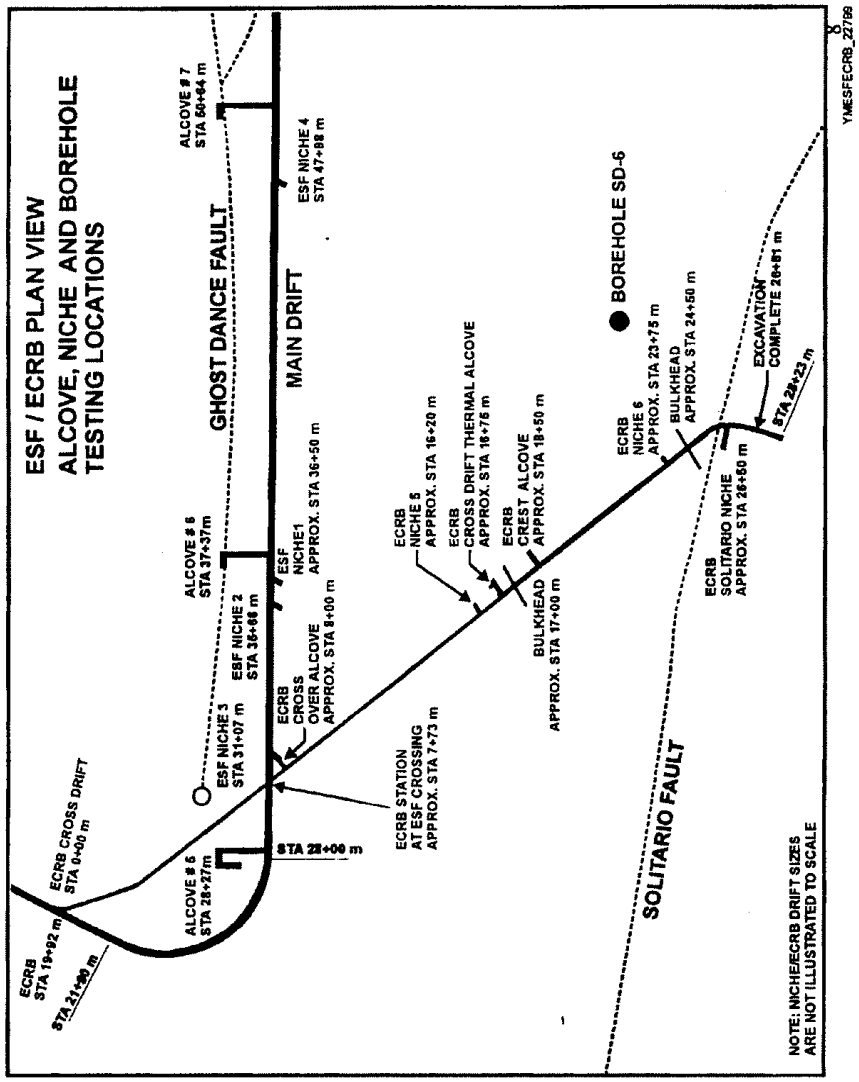
On April 25-26, 2000, the ORs attended NRC/DOE Technical Exchange on KTI Sub-Issues resolution held in Las Vegas, NV. On April 26, 2000, the ORs attended the breakout meeting session to discuss QA-related issues also held in Las Vegas, NV.

On April 27, 2000, representatives of the NRC Division of Waste Management toured Yucca Mountain facilities with representatives from DOE, State of Nevada, Clark County, and the Nevada Nuclear Waste Task Force.

On March 8, 2000, ORs attended (via conference call) the NRC/DOE Technical Exchange on Classification Analysis and Graded Quality Assurance held at NRC Headquarters, in Rockville, Maryland.

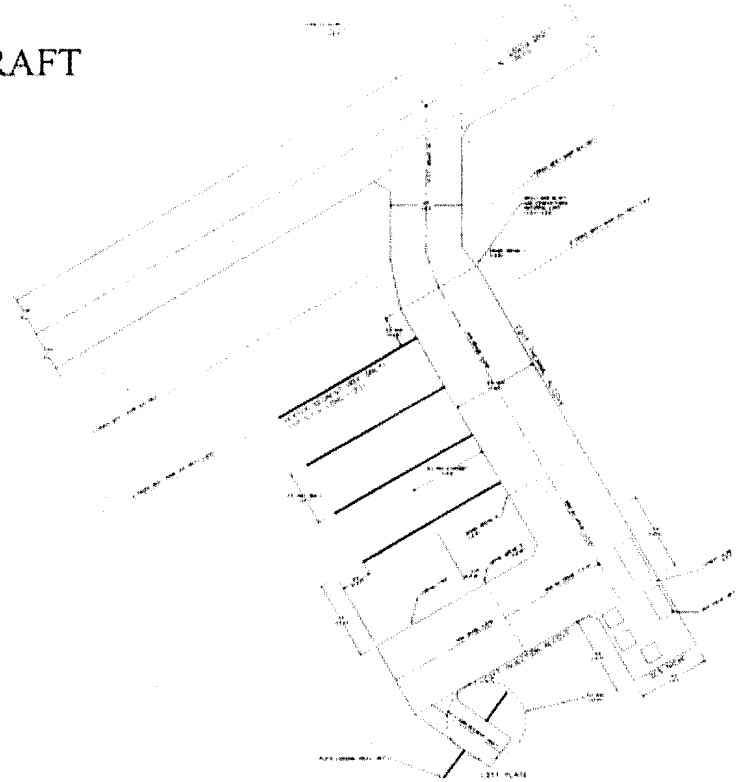
On March 15, 2000, the ORs attended the DOE sponsored “Commitment to Excellence”- All Hands Meeting held in Las Vegas, NV. At this meeting, the DOE/Yucca Mountain Project Manager, DOE Director of QA, and the M&O General Manger presented an overview of prior and existing challenges and the ongoing efforts to building a culture committed to striving toward excellence. Overheads of this meeting were forwarded to NRC Management.

The ORs continue to meet on a bi-weekly basis with the DOE Assistant Manager of Licensing, Assistant Manager of Project Execution, and other DOE staff. The purpose of these meetings is to share ongoing information and any emerging issues/concerns pertaining to the SC/LA efforts. The topics discussed involve the status and progress in resolving open items, technical issues and status, PMR/AMR review status, and any other topics of interest or feedback from NRC/DOE management and staff. The OR’s regard these meetings as a valuable tool for NRC/DOE in providing information and obtaining feedback to keep informed of the current status of current topics of interest.


ESF / ECRB PLAN VIEW
ALCOVE, NICHE AND BOREHOLE
TESTING LOCATIONS
GHOST DANCE FAULT
MAIN DRIFT
SOLITARIO FAULT
BOREHOLE SD-6
ECRB
STA 19+92 m
STA 21+00 m
ECRB CROSS DRIFT
STA 0+00 m
ALCOVE # 6
STA 28+27m
STA 28+00 m
ESF NICHE 3
STA 31+07 m
ALCOVE # 5
STA 37+37m
ESF NICHE 2
STA 35+66 m
ECRB
CROSS
OVER ALCOVE
APPROX. STA 8+00 m
ESF
NICHE1
APPROX. STA 36+50 m
ECRB STATION
AT ESF CROSSING
APPROX. STA 7+73 m
ALCOVE # 7
STA 50+64 m
ESF NICHE 4
STA 47+88 m
ECRB
NICHE 5
APPROX. STA 16+20 m
ECRB
CROSS DRIFT THERMAL ALCOVE
APPROX. STA 16+76 m
ECRB
CREST ALCOVE
APPROX. STA 18+50 m
BULKHEAD
APPROX. STA 17+00 m
ECRB
NICHE 6
APPROX. STA 23+75 m
BULKHEAD
APPROX. STA 24+50 m
ECRB
SOLITARIO NICHE
APPROX. STA 26+50 m
EXCAVATION
COMPLETE 26+81 m
STA 28+23 m
NOTE: NICHE/ECRB DRIFT SIZES
ARE NOT ILLUSTRATED TO SCALE
YMESFECRB_22799

Enclosure 2

DRAFT



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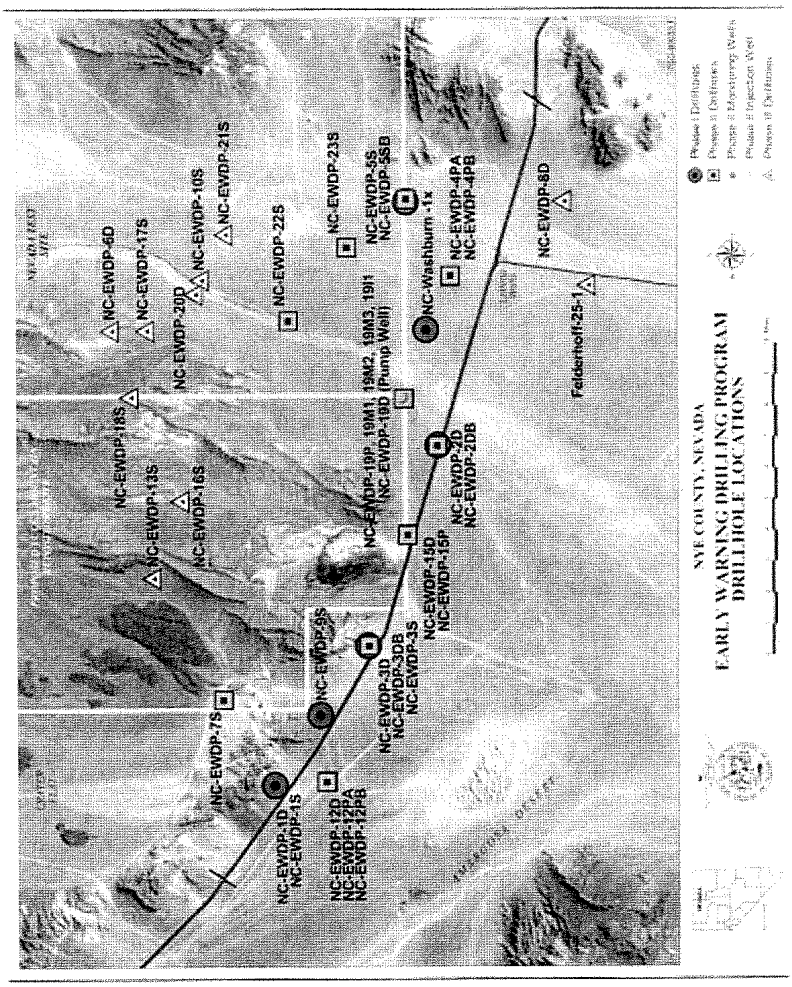
Enclosure 3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NC-EWDP-19D (Pump Well)
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NC-EWDP-15P
NC-EWDP-2D
NC-EWDP-2DB
NC-Washburn -1x
NC-EWDP-3S
NC-EWDP-3SB
NC-EWDP-4PA
NC-EWDP-4PB
NC-EWDP-8D
Felderhoff-25-1
NYE COUNTY, NEVADA
EARLY WARNING DRILLING PROGRAM
DRILLHOLE LOCATIONS

Enclosure 4