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

April 26, 2000

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

FROM: William L. Belke, Sr. On-Site Licensing Representative
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Division of Waste Management
Office of Nuclear Material Safety and Safeguards

Chad J. Glenn, Sr. On-Site Licensing Representative
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SUBJECT: U. S. NUCLEAR REGULATORY COMMISSION ON-SITE LICENSING REPRESENTATIVES' REPORT ON YUCCA MOUNTAIN PROJECT FOR JANUARY 1, 2000, THROUGH FEBRUARY 29, 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 January 1, 2000, through February 29, 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: Recommendations of DOE Survey Report for Ajax Magnethermic Corporation
Enclosure 3: ESF/ECRB Plan View Alcove, Niche & Borehole Testing
Enclosure 4: Early Warning Drilling Program Drillhole Locations
Enclosure 5: EBS Test Configuration
Enclosure 6: Column Testing

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U. S. NUCLEAR REGULATORY COMMISSION

ON-SITE LICENSING REPRESENTATIVES REPORT

NUMBER OR-00-01

FOR THE REPORTING PERIOD OF JANUARY 1, 2000, THROUGH FEBRUARY 29, 2000

/S/

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Enclosures

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1.0 EXECUTIVE SUMMARY

Quality Assurance, Engineering & Key Technical Issues

NRC Open Item 97-2: Data Qualification

DOE issued Corrective Action Request (CAR) LVMO 98-C-002. Verification of data, originally scheduled for 10/29/99, had to be rescheduled again to late March 2000 due to insufficient data available to support closure.

NRC Open Item 99-1: Suppliers not Including Appropriate Technical or Quality Assurance Requirements in Subtier Supplier's Documents

DOE surveillance confirmed the OR observation in response, DOE is drafting a letter to all of its suppliers. Also, the OR recommended that the trending program be revised to alert DOE to supplier conditions adverse to quality.

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 (CAB) established to facilitate closure. Several deficiencies had to be elevated to OCRWM Director to approve extended processing, and new closure dates. Even at the Director's level, several of these deficiency closure dates had to be extended again.

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 was scheduled for verification by 10/29/99. This was rescheduled to late January 2000 and now extended to late March 2000 after it was determined that more information was needed to verify effective implementation.

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. This was scheduled for closure 12/30/99, rescheduled for 1/24/2000, and rescheduled again for late March 2000.

NRC Open Item 00-01: Software (New NRC Open Item)

DOE issued CAR LVMO-98-C-006 on February 10, 1998, for software development and configuration system and processes having been 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 more than 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's efforts to implement the processes established.

OCRWM Qualified Supplier List

December 21, 1999, DOE survey of Ajax Magnethermic Corporation noted seven recommendations, several of which were significant. The recommendation of the survey was that the supplier be placed on the Qualified Suppliers List providing the supplier resolves all of the recommendations. In view of the significance of the recommendations, the OR questioned whether it would be more appropriate that a prospective supplier first demonstrate that acceptable program controls are in place and then be placed on a qualified bidder's list and qualified supplier's list.

Rotational Assignment

A member from the NRC Office of Nuclear Reactor Regulation's Division of Licensing and Project Management Branch is on a four-month rotation to the Division of Waste Management. Part of this assignment has been to support OR office for several weeks. One of his major involvements has been in the data verification process.

Exploratory Studies Facilities (ESF) & NRC Key Technical Issues

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

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

Seepage Testing

Systematic borehole percolation flux and seepage testing started in the cross-drift in late February 2000. In Alcove #7, monitoring of natural infiltration at surface and moisture conditions in alcove continues. Seepage testing was completed in two niches and continues at several other sites.

Drainage Testing

Infiltration testing will be done at, up to 6 locations in ECRB to determine properties for unsaturated site-scale percolation model. Traced water will be applied to the surface of each bench and infiltration monitored. Testing is expected to start in March 2000.

Passive Hydrologic Test

Since June 1999, steel bulkheads have cutoff ventilation to the ECRB beyond Station 17+63. The test objective is to allow the moisture condition in this section of ECRB to return to ambient to determine if dripping can be observed from the rock-mass. Ambient conditions in this section of ECRB are expected to return in several months.

On January 13th, DOE scientists entered this area and observed condensation and mold. On February 14th, DOE scientists reentered this area to sample the mold. DOE has approved additional funding for installation of drip indicators and other activities in support of this test.

Cl-36 Validation Study

Testing is to verify presence of bomb pulse Cl-36 previously detected at the Sundance Fault and other locations in the ESF. USGS reports that tritium analyses of water extracted from 11 coreholes in the Sundance Fault yielded no measurable amount of tritium; however, other analyses are awaiting completion. Study is expected to be completed before the end FY 2000.

Alcove 5 Heated Drift Test

DOE plans to cut output of heaters to keep surface temperature of wall rock below 200°C. DOE is considering funding a study to constrain heat mass flux through the Heated Drift bulkhead. In addition, DOE is converting a protocol for water sampling and field analyses into a YMP procedure.

NYE County Drilling and Testing

In January 2000, Nye County began their Phase II drilling program. Nye County reported elevated radioactivity levels in water collected from well NC-EWDP-4PA, and is resampling this well to verify results.

Busted Butte Unsaturated Zone Transport Test

Phase II tracer injection 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. In March 2000, DOE plans to drill 3 boreholes and sample core to better define tracer pathway. In April 2000, test results are to be documented in unsaturated zone/saturated zone transport report.

EBS Test #3, Drip Shield Test

This test was completed with the following post-test observations: (1) inside of drip shield was dry; (2) drip shield creates an environment around waste package that is warmer than the drift, which lowers relative humidity and inhibits condensation; (3) salt deposits visible on crushed tuff invert and on outside surface of drip shield; and (4) condensation was observed on underside of test cell.

EBS Test #4, Drip Shield and Backfill (Overton Sand)

Test started in December 1999. On February 17, 2000, a drip system started applying water to test cell at a rate of 250 ml/hr. In late February, DOE scientists reported that water reached the invert and was being drawn from the test cell at a rate of 9 liters/day.

EBS Column Testing

These tests are designed to replicate results of previous testing. In the test, circulating waters are reported to have elevated pH, and minerals from the crushed tuff invert were dissolved and their constituents deposited as hard residue at bottom of test cell. Liquid samples and welded tuff samples were extracted for laboratory analyses.

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 January 1, 2000, through February 29, 2000.

3.0 OBJECTIVES

A principal function of the OR mission is to 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 of the NRC QA Open Items and the progress associated with the"DOE Management Plan and Response to Corrective Action Requests" as delineated in the January 25, 1999, letter from R. Dyer to J. Greeves is listed below.

  The June 11, 1999, letter from J. Younker to R. Clark, listed a comparison of the Corrective Action Requests (CARs) noted in the January 25, 1999, letter. The results of this comparison indicated that the Civilian Radioactive Waste System Management System Management and Operating Contractor (M&O) intended to meet the due dates specified in the January 25, 1999, letter. DOE established an Office of Quality Assurance CAR Verification Team to perform verifications of commitment actions noted in the M&O CAR Management Plan. The team performed two separate detailed verification efforts visiting the National Laboratories, U.S. Geological Survey (USGS), and the M&O in Las Vegas, NV. For these efforts, the team noted that the dates indicated in the CAR Management Plan are questionable. A third verification effort 6 started in November 1999, and is presently continuing through the year 2000. As reported at the December 16, 1999, NRC/DOE Management/Quality Assurance meeting, sufficient implementation of PVAR processes and data verification/qualification

activities has not been achieved to support OQA closure of the remaining open CARs.Anticipated closure dates by DOE have slipped several times due to ineffective implementation and what appears to be lack of DOE QA/M&O Management to elevate lengthy open CARs to the next level of DOE/M&O management for further action as opposed to extended processing. Current status and explanation of this effort are reported below.

97-2 DATA QUALIFICATION

(Ref: DOE CARS LVMO-98-C-002 (Data Qualification).

As a result of increased deficiencies surfacing during DOE audits/surveillances of its suppliers, the OR questioned whether the data/products produced by these suppliers would be acceptable and appropriately qualified for potential Site Recommendation (SR) or the License Application (LA) efforts. CAR LVMO-98-C-002 was ultimately issued and all data obtained by the M&O and USGS suppliers were identified and are still in process of being evaluated. The impact on data produced by the applicable suppliers is also being evaluated by DOE. A determination on whether this data needs to be qualified for either SR or LA will be taken into consideration. The procedure for processing of technical data was revised and is now Office of Civilian Radioactive Waste Management Procedure AP-SIII.3Q, "Submittal and Incorporation of Data to the Technical Data Management System," effective 6/30/99. All data for CAR-002 was scheduled to be verified by October 29, 1999, and all "To Be Verified" (TBV) data was to be resolved by January 20, 2000. Subsequent to the anticipated verification date of 6/30/99, it was decided that more of the data qualification processes would need to be evaluated to gain confidence that the revised process is being effectively implemented. The DOE QA organization has determined that verification would be needed to be extended to at least the audit of the UZ Flow and Transport PMR scheduled for 1/24/00. At this time, there were insufficient data/verification activities available and the planned verification/closure has been rescheduled to late March 2000. It should also be noted that the planned audits for April/March 2000 have been postponed, and consequently, surveillances will need to be performed to supplement reviews of the verification data.

99-1 QA/TECHNICAL REQUIREMENTS NOT INCORPORATED

CAR-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 effective corrective actions at each of the affected organizations (National Laboratories, and USGS). Part of these 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 documents. The M&O and affected organizations were also required to ensure that all applicable technical and QA requirements were included into M&O procurement documents to suppliers. DOE felt that the M&O initiated sufficient corrective actions to address and close 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 in nine of the suppliers not including technical or QA requirements into their sub-tier supplier's documents. DOE QA personnel consider this an isolated instance because it only occurred once with each supplier to sub-tier supplier procurement. Based on the audit/surveillance findings, DOE considers the actual findings to be insignificant and does not warrant removal of the supplier from the Qualified Supplier's List and that the DOE QA supplier

audit program overall, 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 technical and QA requirements into subtier supplier procurement documents appears to be a problem area with several of the OCRWM qualified suppliers that warrant attention and communication with all qualified suppliers. The NRC OR does not consider this issue to be insignificant and recommended that DOE issue a strong generic letter directing all suppliers to fully comply with the DOE QARD requirements. This would include special attention to reviewing and ensuring that all suppliers and subtier suppliers ensure appropriate, technical, and QA requirements are included into procurement documents. This letter has been in the process of being drafted since October 1999. The NRC OR has requested to be placed on distribution for this letter when it is issued. Also, in the future, the DOE trending program should have the capability to notify appropriate management when similar deficiencies are observed at individual suppliers. When similar conditions are detected, all suppliers and subtier suppliers should be notified and alerted of these conditions. DOE initiated a special surveillance effort to confirm the extent of the above OR observations about not appropriately incorporating technical and QA requirements. This issue will continue to be carried as NRC Open Item 99-1.

98-1 LENGTH OF TIME TO CLOSE DEFICIENCIES

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 in 1994 for this same deficiency (CAR-LVMO-94-C-010). This does 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 February 29, 2000, DOE trending deficiency list noted there were 33 open deficiencies with several still remaining open in excess of two years.

98-3 MODEL DEFICIENCIES

(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 Assessment -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. The findings from these reports were perceived by

NRC to be of significance such that it was necessary to track the corrective action through NRC Open Item 98-3.

An implementation action plan has been developed by the line organization resulting from the issuance of CAR LVMO-98-C-010. The intent of this plan will be 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 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 has now been changed to late March 2000.

98-4 TRACEABILITY
(Ref: CAR LVMO-99-C-001)
As a result of the October 1998, DOE performance-based audits of the M&O, CAR LVMO-99-C-001 was issued because technical data referenced in Viability Assessment technical documents was 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 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.

SOFTWARE - NEW NRC OPEN ITEM 00-01
On February 10, 1998, CAR LVMO-98-C-006 was initiated because software development and configuration systems and processes were 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. As of February 29, 2000, CAR 98-C-006 has been open 748 days.

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 9 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 QA Management therefore determined that the process established for software management is ineffective. Consequently, actions are in process to issue a new CAR LVMO-00-C-001 and four new Deficiency Reports to close CAR LVMO-98-C-006 to address the ineffectiveness of the M&O to implement the processes established. There may also be a letter generated by the OCRWM Office Director on this matter. Should this letter be generated, the OR has requested to be

placed on distribution. Because of the importance of this issue, this will be tracked as a new NRC Open Item 00-01.

OCRWM QUALIFIED SUPPLIER LIST

In the DOE Survey Report for Ajax Magnethermic Corporation dated February 4, 2000, the DOE audit conclusion recommended that this potential supplier be placed on the OCRWM Qualified Supplier List pending they resolve all of the recommendations identified in the Survey Report prior to performing quality-affecting work. (Enclosure 1 provides a listing of the seven recommendations noted by the DOE auditor.) Ajax Magnethermic Corporation designs and manufactures heat induction and related equipment for melting, heating, and heat treating.

The scope of work for this effort is for technical services consisting of performing feasibility testing and analysis of induction heating of mock waste package closure welds to reduce or mitigate the residual tensile stresses. The OR considered these recommendations to be substantive in nature and questioned why this supplier should even be recommended to be placed on the qualified list in view of these deficiencies. It would appear more appropriate that a prospective supplier first demonstrate that acceptable program controls are in place and then be placed on a qualified bidder's list and qualified supplier's list.

PRESENTATION TO NV LEGISLATURE COMMITTEE

On February 4, 2000, the OR presented the NRC's perspective status of DOE's QA Program to the Nevada Legislature Committee on High-Level Radioactive Waste. The NRC Chief of the NRC High-Level Waste and Performance Assessment Branch also briefed the Committee on the status of NRC KTIs, the proposed amendments to Title 10 of the Code of Federal Regulations, Part 63, and Spent Nuclear Fuel Shipping Cask licensing review. DOE presented an overview of the Draft Environmental Impact Statement status, and the status of the ongoing scientific investigations. There was no DOE QA representation at this meeting.

ROTATIONAL ASSIGNMENT

A member from the NRC Office of Nuclear Reactor Regulation's Division of Licensing and Project Management Branch is on a four month rotational duty to the Division of Waste Management. As part of this rotational assignment, the individual had the opportunity to spend two weeks at the OR office and participate in the daily OR activities, including the above NRC Open Items, and have a series of discussions with DOE and DOE contractor personnel.

One of the more significant discussions involved the issue of data verification process evaluation relative to the "to be verified" (TBV) and "to be determined" (TBD) data used as direct input to the Analysis and Process Model Reports. This methodology is described in AP-3.15Q, "Managing Technical Product Inputs." Discussions were held with individuals in the Data/Software Qualification Department, and several data sets or Data Tracking Numbers (DTNs) were reviewed to gain insights of the verification methodology to resolve TBV's and TBD's. For this process, it was determined that the TBV/TBD resolution packages are developed for the specific DTN's in order to uniquely identify and link the objective evidence demonstrating qualification of the DTN's. The TBV/TBD packages are also used to document that there are outstanding issues affecting data qualification from other ongoing corrective actions including procurement, software and modeling concerns. The data verification process is limited to those DTN's

that are identified as requiring verification in the Technical Data Management System (TDMS) and are referenced in the AMR/PMR. It was also discovered that the completed TBV/TBD resolution packages provided records pertaining to the following areas as applicable, completed data or technical information conformation checklist; procurement checklist; documented resolution of items identified in the data confirmation checklist; notification of any TBV resolution concerns; and the signed acceptance sheet demonstrating the contents of the package have been appropriately processed.

Based on the review of selected DTNs it was ascertained that the verification process which applies to either acquired or developed data provided for completion of confirmation, development of record road maps, and the identification of supporting records, including traceability to the TDMS and between the related records packages. It was also determined that the completed data confirmation checklists established controls for procurement activities in accordance with applicable procurement (LP-16.1Q) and software(AP-S1.1Q) procedures.

For this reporting period, the M&O indicated that the presently known population of unique data sets identified by DTN that have been categorized as supporting AMRs/PMRs numbers about 1300.

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

Enhanced Characterization of the Repository Block (ECRB)

DOE continues 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 the ESF and ECRB test locations.

The excavation of the ECRB, or "cross-drift," completed on October 13, 1998, allows the collection of scientific and engineering data in the potential repository block to support the characterization of the Yucca Mountain site. Temperature, relative humidity, barometric pressure, air flow velocity, rock-mass moisture, and construction monitoring data continues to be collected in the cross-drift.

Passive Hydrologic Test (17+63 - 28+23):
Since June 1999, a section of the ECRB has 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 part of the ECRB to return to ambient (preconstruction) moisture and temperature conditions. 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, which had previously shown evidence of rock drying under ventilation, continue to show evidence of rewetting. However, DOE scientists state that moisture conditions in 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%. Resealing the bulkheads causes the relative humidity to rise to about 85% in just several days, and it rises gradually over the following weeks to 96% or greater.

Over this period, the bulkheads were opened on two occasions. On January 13, 2000, DOE scientists opened the bulkheads to collect data and perform visual observations of potential re-wetting on rock surfaces. No free water or dripping from rock surfaces was observed. However, DOE scientists did observe condensation on both the ventilation line and conveyor belt near the second bulkhead. This water was sampled for chemical and isotopic analyses. The presence of mold was also observed at a couple of locations. On February 14, 2000, DOE scientists re-entered this area to sample the mold to characterize this material and better understand the conditions that promote its growth.

Over this period, DOE approved additional funding for this passive test. This funding will support the following activities: 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; and 3) further characterization of organic material. DOE currently plans to continue this testing through FY-2000.

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 zone. This niche will eventually be excavated to a depth of approximately 30 meters. To date, a 14-meter access drift has been excavated. Over this reporting period, DOE drilled seven boreholes at the end of this access drift for air permeability and liquid release testing. This testing started in late February 2000. After completing this initial 60-day testing period, constructors will extend the excavation 12 approximately 15 meters and a final series of radial boreholes will be drilled from this 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.

Alcove 8 (8+00):
This alcove will be constructed to conduct seepage testing from the Topopah Spring Upper lithophysal zone to the underlying Topopah Spring Middle nonlithophysal zone. This alcove will be excavated to a depth of approximately 30 meters. To date, this excavation has advanced approximately 25 meters. After this alcove is excavated, 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 below this alcove and will be used in this infiltration test. A series of 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 the near-field and unsaturated zone flow and transport process model reports.

Systematic Boreholes:
Project scientists plan to conduct a systematic hydrological investigation of fracture flow and transport properties in the cross-drift. Approximately 20 boreholes will be drilled 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. This drilling and testing started in late February 2000. Test results will feed the unsaturated zone flow and transport process model report.

Drainage Tests:
Two of six drainage benches have been excavated over this period. These 1-meter X 1-meter X 0.5-meter high benches will be used to conduct infiltration tests. Drainage benches are planned at the following ECRB Station locations: 11+15, 13+00, 15+19, 17+34, 22+15 and 24+25. This testing is expected to start in March 2000.

An infiltration system will be mounted on the surface of each bench and traced water applied. The objectives of this test are to:

- Develop data for the purpose of designing engineered drains in the emplacement drifts, if needed.
- Verify properties of welded tuff used for the unsaturated site-scale percolation model.
- Determine water potential of host rock and invert material for given fluxes.
- Correlate measured drainage properties to mapped fractures to understand spatial variability of drainage properties.

Exploratory Studies Facility Testing

Moisture and construction monitoring continue in the ESF. DOE scientists are proceeding with a study to validate the presence of bomb-pulse chlorine-36 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 will be analyzed for chlorine-36, tritium, technetium-99, and supplemented by analyses of uranium, thorium, iodide-129 and radium isotopes. Over this period, USGS reported (Yucca Mountain Project Branch - USGS Progress Report, January 2000) on results of tritium analyses from the Sundance Fault and other locations in the ESF. A final report on this study is expected to be submitted to DOE before the end of FY 2000.

Alcove 1:
The second phase of the artificial infiltration test continued over this reporting period. In this phase of testing, scientists continue to vary the surface application rate of traced construction water. Since the start of this phase of testing on February 19, 1999, through February 29, 2000, approximately 433,444 liters (114,504 gallons) of water have been applied at the surface and approximately 75,042 liters (19,824 gallons) collected in Alcove 1. Initial breakthroughs 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 (concentration 220 parts per million) 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 water at the surface to monitor the tail-off of tracer concentration. Project scientists

believe breakthroughs of this tracer occurred on approximately November 25, 1999. Concentration of lithium bromide traced water is presently approximately 160 parts per million. 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 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 activities. 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, there were no new activities conducted in Alcoves 3 and 4. DOE scientists plan to install moisture monitoring instrumentation in two existing 30 meter deep boreholes. One borehole was drilled from the invert in Alcove 3, and the second borehole was drilled from the crown in Alcove 4. This instrumentation will be used to better understand 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 14 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 boreholes around the heated drift. A data collection system records measurements from these sensors.

On February 23, 2000, sensors in the heated drift recorded the following temperatures: canister temperature of 194.4° Centigrade (382° Fahrenheit), rock-mass surface temperature of 189.4° Centigrade (373° Fahrenheit), and air temperature of 194.4° Centigrade (382° Fahrenheit). In the weeks ahead, DOE plans to scale back the thermal output of heaters to maintain drift wall rock temperatures below 200° Centigrade (392° Fahrenheit).

Over this reporting period, DOE scientists collected approximately 800 ml of water from Boreholes 59 (zone 2), 90 ml from Borehole 77 (zone 2), and 110 ml from Borehole 77 (zone 3). Other boreholes (Borehole 58, 60, 74, 75, 76, and 186) were also pumped, but no water was observed. DOE plans to discuss the results of these water analyses in their next thermal test workshop.

In the OR Report for April 1 - May 31, 1999, it was noted that DOE scientists were employing a field protocol for obtaining and testing water samples from boreholes for

the Drift Scale Test. DOE continues to use this protocol, with entries to a Scientific Notebook, to collect and test these water samples. DOE is now in the process of converting this protocol into a controlled procedure, which is expected to be issued in March 2000. The OR has requested a copy of this procedure when it is issued.

Although DOE thermal test modelers feel that heat and mass loss through the bulkhead is adequately addressed in their models, in response to NRC staff concerns, DOE is considering conducting an investigation to better constrain heat mass flux through the Headed Drift bulkhead. The OR will continue to monitor developments in this area.

Alcove 6 (Northern Ghost Dance Fault Alcove):

Over this reporting period, there was no new testing conducted and no further work is planned in this alcove.

Alcove 7 (Southern Ghost Dance Fault Alcove):

Excavation of this alcove cut the Ghost Dance Fault at station 1+67. At this location, the fault is approximately one meter wide with a vertical offset of approximately 25 meters. Two steel bulkheads have been constructed in this alcove to isolate and test two different zones (a non-faulted zone from 0+64 to 1+34, and a faulted zone from 1+34 to 2+00). Since November 1997, water-potential data has been collected from 51 probes in the rock mass surrounding Alcove 7, and from 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. DOE scientists entered this alcove in February 2000 to download data and collect samples of mold.

Niche #1 (35+66):

The steel bulkhead for this niche was closed in January 1998, to monitor in-situ moisture conditions. Over this period, DOE scientists completed the data collection in this niche. No further work is planned in this niche.

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. DOE scientists completed seepage threshold testing in Niches #2 and #3. 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. UNLV scientists plan to conduct their next quarterly status meeting on this study in June 2000.

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) then 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 Stations 65+00 and 70+00. The stability of each end monument is monitored relative to the bottom of two cored boreholes. The bulk of the installation will consist of drilling and grouting instrument packages in boreholes, construction of monuments to secure the system, installation of brackets to support the vacuum tube, and the installation of the strainmeter and data collection system. The four instrument boreholes were drilled over this period. Installation of instrumentation and initial data collection is expected to start over the summer of 2000.

Surface-Based Testing

Nye County Drilling and Testing:

Over this period, Nye County received the necessary clearances to proceed with their Phase II Drilling Program. Planned Phase II drilling includes boreholes NC-EWDP-4PA and 4PB, NC-EWDP-7S, NC-EWDP-12D, NC-EWDP-15D, NC-EWDP-22S, NC-EWDP-23S, NC-EWDP-3DB, NC-EWDP-2DB, NC-EWDP-5SB, NC-EWDP-10S, and NCEWDP-19 well complex. Enclosure 3 shows the location of these boreholes.

On February 29, 2000, Nye County reported that preliminary geochemical analyses of a water sample from borehole NC-EWDP-4PA yielded higher than background levels of radioactivity. This borehole will be resampled to verify these initial results.

Over the past year, Nye County, in cooperation with the United States Geological Survey, completed a low-level aeromagnetic survey to better understand near surface geology and hydrology in the vicinity of Yucca Mountain and Amargosa Desert. A report documenting the results of this study was completed in February 2000.

Characterization of Near Surface Velocity:
In the March-April 2000 time frame, DOE plans to initiate a study to characterize the near surface velocity structure of Yucca Mountain. 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.

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. Tracer testing is designed to proceed in phases.

Phase I tracer injection started in early 1998 and was completed by late 1998. Phase I included a total of eight 2-meter deep boreholes (six single point injection boreholes and two collection boreholes). Mixtures of nonradioactive tracers were injected at rates of one and ten milliliters per hour (ml/hr) in an effort to bound potential infiltration rates of 30 and 380 millimeters per year (mm/yr). Investigators completed the mine-back of a portion of the Phase I test-bed to determine tracer migration rates and pathways. According to DOE scientists, preliminary results of Phase I testing provide evidence for matrix diffusion and capillary flow in the geologic Calico Hills Formation, and indicate that lithologic contacts may also impede flow in this stratigraphic unit.

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 recently decided to continue injecting through FY 2000. The Phase II test includes eight injection and twelve collection boreholes ranging from seven to 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. DOE scientists have detected tracer breakthrough at collection boreholes from the 10 and 50 ml/hr injection boreholes, but no breakthroughs have 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 April 2000. In March 2000, DOE plans to drill 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, 17 LTD. (AECL) for use in radionuclide transport testing at the AECL laboratory. Preparations are underway to initiate radionuclide transport testing on these blocks. In the March 2000 time frame, preliminary testing will be conducted on a smaller block of tuff, using Tc-95m, 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. EBS testing is 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 #3, Drip Shield Test:

This test was terminated on November 11, 1999. This test consisted of a stainless steel drip shield, a crushed welded tuff invert, and no backfill. The test configuration is illustrated in Enclosure 4. The test cell wall temperature was maintained at 60° Centigrade (140° Fahrenheit), and the simulated waste package was maintained at 80° Centigrade (176° Fahrenheit). A drip system, installed on the top of the test cell, applied water at a rate of 250 ml/hr/meter. Two different suction rates, 40 cm/second and 100 cm/second were applied to draw water from the invert. DOE scientists report the following post-test observations:

- The inside of the drip shield was dry. The inside surface of the drip shield did not show any condensation.
- Condensation was observed on the underside of the test cell.
- The drip shield creates an environment around the waste package that is warmer than the drift, which lowers the relative humidity inhibiting condensation. The surface of the simulated waste package also did not show any condensation.
- Salt deposits were visible on the crushed tuff invert (white powder) and on the outside surface of the drip shield.

EBS Test #4, Drip Shield and Backfill:

In December 1999, the first phase of the test started and consisted of determining the response of the test system to heat. The test is now determining the response of the system with drip shield, backfill, dripping water and heat. The backfill is Overton sand.

The primary objective of Test #4 is to simulate the movement of moisture (water dripping from the roof of the emplacement drift) as it moves through the backfill and is removed by 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. The simulated waste package, made of mild carbon steel, 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 temperatures. The cell wall temperature is maintained at 60°Centigrade (140° Fahrenheit), and the waste package is maintained at 80° Centigrade (176° Fahrenheit). On February 17, 2000, a drip system started applying water at a rate of 250 ml/hr/meter. DOE scientists report that dripping water has reached the invert and is being drawn out of the system at a rate of 9 liters per day.

EBS Test #5, Breached Waste Package:

Test #5 is being planned. The primary concepts for this test have been developed in coordination with the Waste Package Department and Subsurface Facilities Department. This test will investigate the pooling of water in a breached waste package and the environment in the test cell at which pooling might occur in the waste package. This test will be configured to run at several power outputs from the waste package and at several drip rates. The power output will be varied from 5-100 Watt per waste package. The drip rate will vary from 5-75 liters/year. The test will be conducted without backfill or a drip shield. Plans are underway to finalize the test configuration, instrumentation location, drip method, and schedule for the test.

Column Test #1:
In December 1999, DOE terminated a column test using crushed tuff. This test was designed to replicate a previously reported test by Rimstidt (Rimstidt and Williamson 1991). The test configuration is illustrated in Enclosure 5. When terminated the test had operated for twelve days. During this period, the circulating de-ionized water reached a pH of more than nine. The polycarbonate tubing used to fabricate the test cell was etched causing the cell to leak. Minerals were dissolved from the crushed welded tuff and deposited as hard residue. These materials as well as liquid samples are being analyzed.

Column Test #2:

This test was started on January 5, 2000. The polycarbonate tubing was replaced by underground grade PVC pipe. This test was terminated after 22 days of operation. Liquid samples and altered welded tuff samples were extracted and sent for laboratory analyses.

Test Support Facility
EBS Test Support Facility, Building B-4, is now available for laboratory tests. This facility has been used to measure thermal conductivity, moisture content, particle size distribution, and other similar tests.

6.0 GENERAL

1. Appendix 7 Interactions
January 26, 2000, the Deputy Director of the NRC Division of Waste Management, a member of the NRC Office of General Counsel, and the OR's visited the Yucca Mountain Site.

February 9, 2000, three representatives of the Division of Waste Management and an OR visited the Yucca Mountain site. The purpose of these visits was to obtain an overview of DOE's site characterization activities. There were no outstanding issues raised as a result of these visits.

2. Other

January 6, 2000, the ORs met with the newly appointed DOE OCRWM Director, Ivan Itkin, to discuss general issues associated with the Yucca Mountain project. January 11, 2000, the OR staff attended the Department of Energy's public hearing on the Draft Environmental Impact Statement (EIS) for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste held at the Grant Sawyer State Building in Las Vegas, NV. DOE personnel gave a brief overview of the EIS followed by a question and answer session. The remainder of the hearing was reserved for public comments.

January 25, 2000, the ORs attended the Nuclear Waste Technical Review Board Meeting held in Las Vegas, NV.

February 3-4, 2000, an OR and several Division Waste Management and Center staff attended a field trip to observe the faults associated with the magnitude 7.1 Hector Mine earthquake in the Mojave desert. Reports on the active faults and Hector Mine earthquake are due to be published this year.

RECOMMENDATIONS OF DOE SURVEY REPORT FOR AJAX MAGNETHERMIC CORPORATION

1. There are no procedures in place that describe the qualification of Suppliers or acceptance of services for quality affecting work. Additionally, there is no objective evidence available to evaluate the continuing performance of the supplier.

2. There are no procedures in place that describe the process for including technical and quality requirements in quality-affecting purchase orders or the review of purchase orders. Several purchase orders were found to contain appropriate technical requirements but none of the purchase orders included quality requirements to subtier suppliers.

   Items 1 and 2. It is recommended that Ajax Magnethermic Corporation write a procedure that describes the process for the qualification of suppliers, acceptance of services and require that purchase orders include quality and technical requirements. Additionally, it was pointed out to Ajax Magnethermic Corporation that they could use approved suppliers on the OCRWM QSL for calibration services.

3. There are no procedures in place that describe the process for writing procedures. Ajax Magnethermic Corporation has a good process for the control and approval of documents, but there is no procedure to describe the content of the technical procedure. It is recommended that Ajax Magnethermic Corporation write a procedure that describes the process for writing procedures.

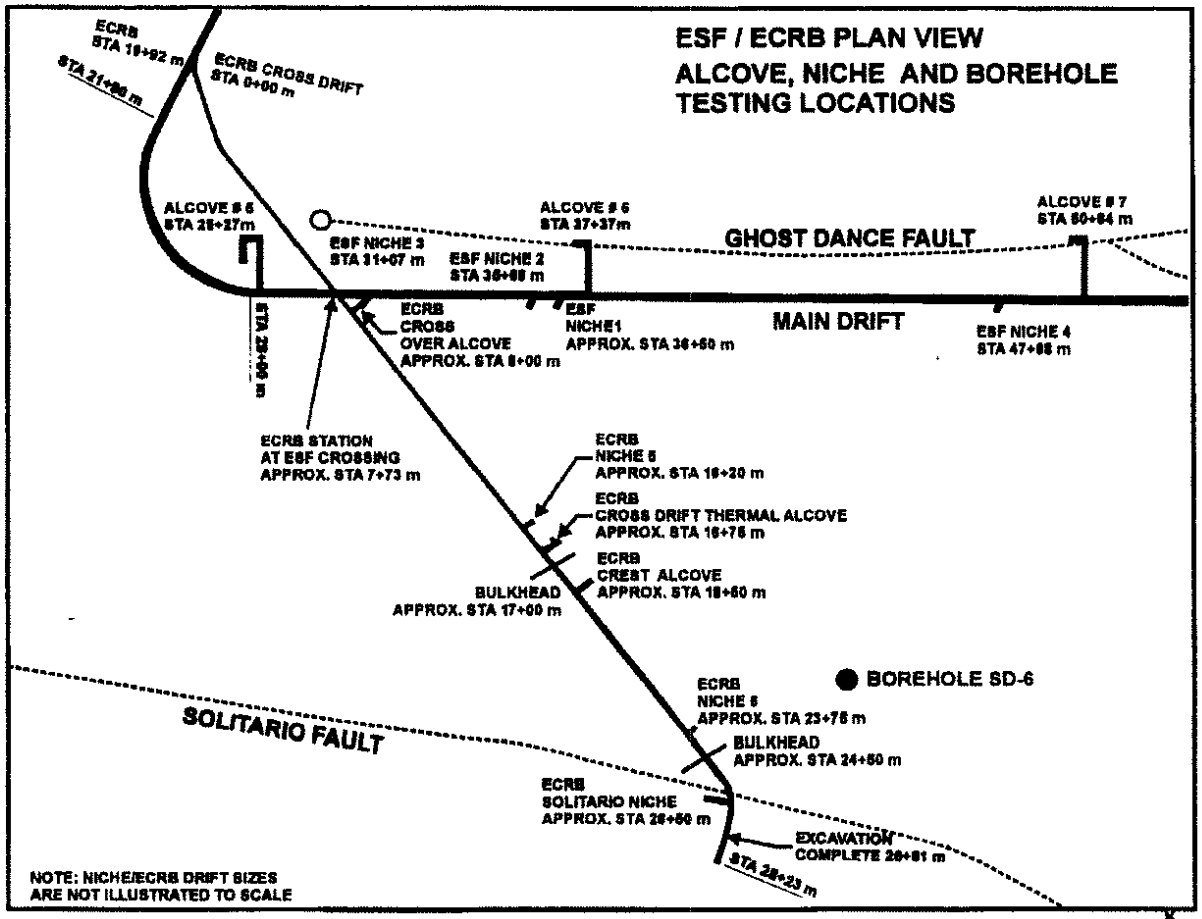
4. There are no documented plans or procedures for prescribing the requirements for the Heat Treating Processes or for the identification and control of the samples being treated. All information is recorded on a Heat Treating Process Data Sheet. It is recommended that an instruction or procedure be developed that describes the parameters of the heat treating process as well as controls for maintaining proper identification of the material being treated or possibly documenting processes in a scientific notebook.

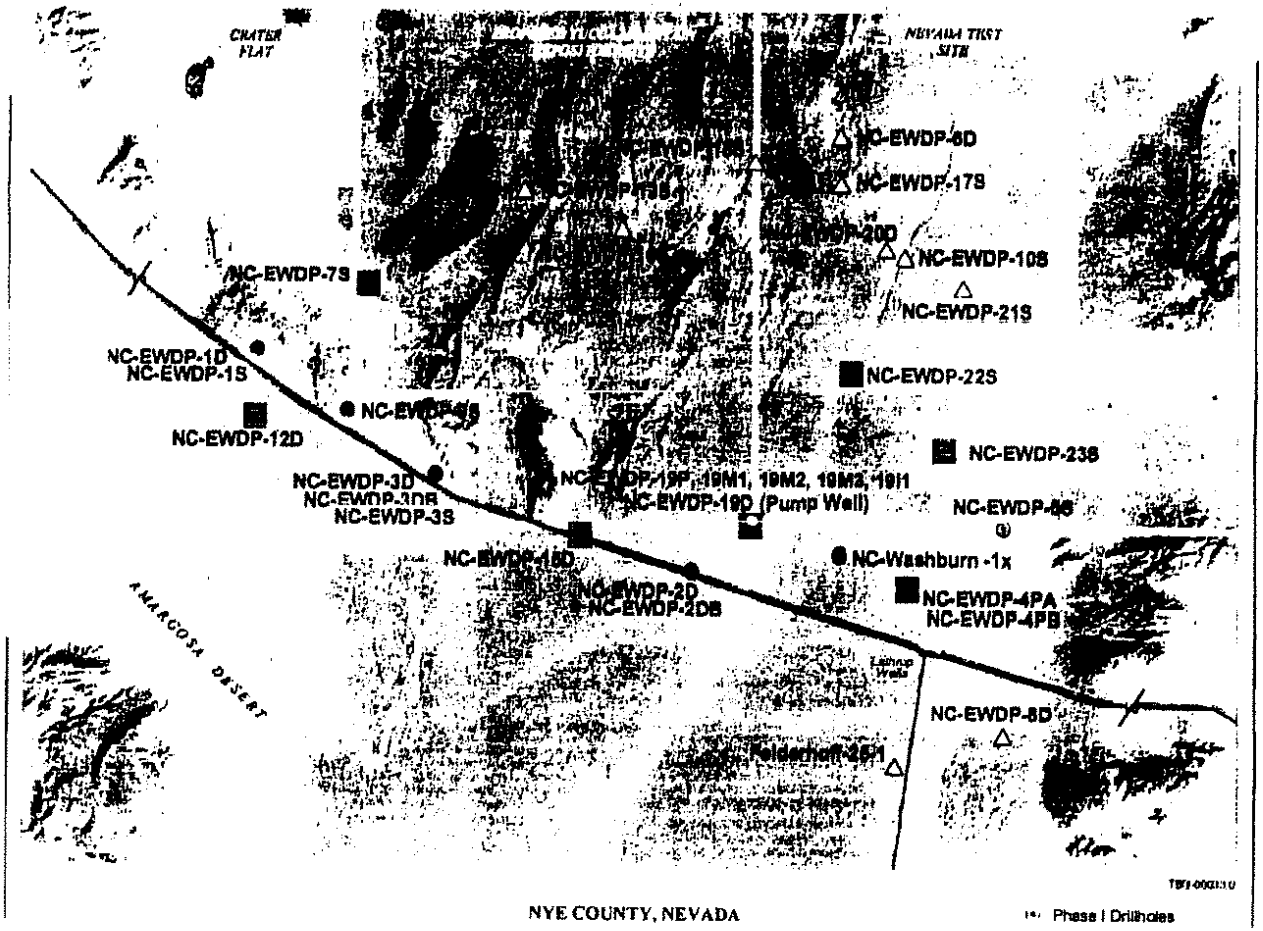
5. Measuring and test equipment was observed to not have the proper status indicator, i.e., no sticker at all or past due calibration or calibrate before use and some instruments were bing used that were past due for calibration. It is recommended that the calibration system be evaluated to assure that all measuring and test equipment, which will be used for the Yucca Mountain Project Work, has the appropriate status indicator attached to the instrument, and that the equipment is within current calibration.

6. Corrective action was ineffective for assuring that Measuring and Test Equipment that was past due for calibration was not used. A Data Logger SN#31324031 used in the heat treating process, was used while past due for calibration. This condition was documented on Ajax Magnethermic CAR 258, dated December 10, 1999, but the instrument was still being used. It is recommended that the corrective action system be evaluated to assure these types of conditions are corrected in a timely manner.

7. Records are stored by the responsible manager for the activity or job. Since there is no central location for the storage of records and the storage of records do not meet the requirements of the Quality Assurance Requirements Description for temporary storage, it is recommended that the procurement documents identify those records needed to support the activity and have them submitted to the project, or Ajax Magnethermic Corporation shall develop a procedure for dual storage of unique one-of-a-kind records.

Enclosure 3


ESF / ECRB PLAN VIEW
ALCOVE, NICHE AND BOREHOLE
TESTING LOCATIONS
ECRB
STA 19+92 m
STA 21+96 m
ECRB CROSS DRIFT
STA 0+00 m
ALCOVE # 5
STA 25+27m
ALCOVE # 6
STA 37+37m
ALCOVE # 7
STA 50+84 m
GHOST DANCE FAULT
ESF NICHE 3
STA 31+07 m
ESF NICHE 2
STA 36+68 m
ECRB
CROSS
OVER ALCOVE
APPROX. STA 8+00 m
ESF
NICHE1
APPROX. STA 38+50 m
MAIN DRIFT
ESF NICHE 4
STA 47+88 m
STA 29+96 m
ECRB STATION
AT ESF CROSSING
APPROX. STA 7+73 m
ECRB
NICHE 5
APPROX. STA 16+20 m
ECRB
CROSS DRIFT THERMAL ALCOVE
APPROX. STA 16+75 m
ECRB
CREST ALCOVE
APPROX. STA 18+50 m
BULKHEAD
APPROX. STA 17+00 m
BOREHOLE SD-6
ECRB
NICHE 6
APPROX. STA 23+75 m
SOLITARIO FAULT
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
YMESPECRB_22799



NYE COUNTY, NEVADA

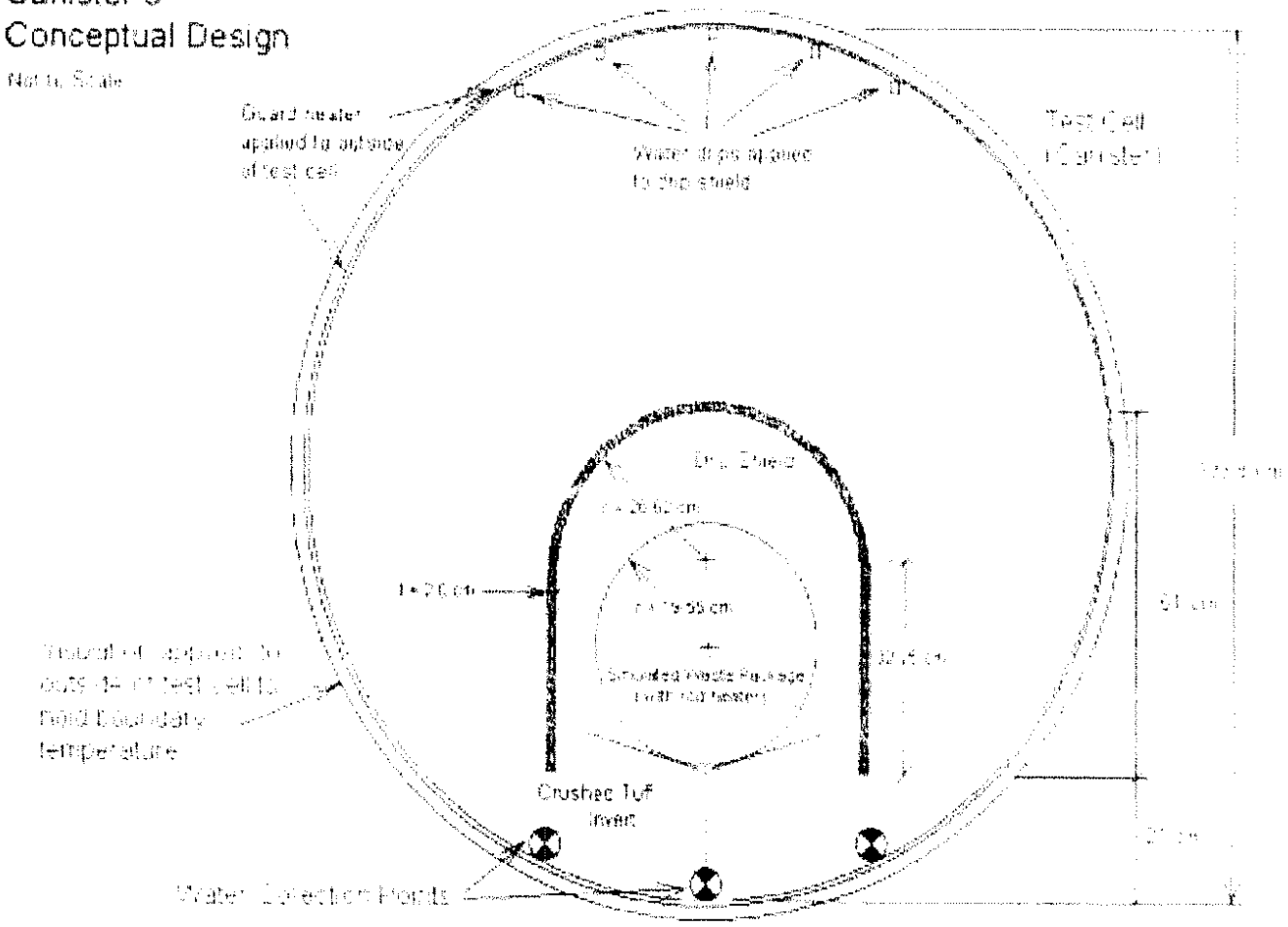
EARLY WARNING DRILLING PROGRAM
DRILLHOLE LOCATIONS

Enclosure 4

EBS Test Configuration

Engineered Barrier System
Canister 3
Conceptual Design

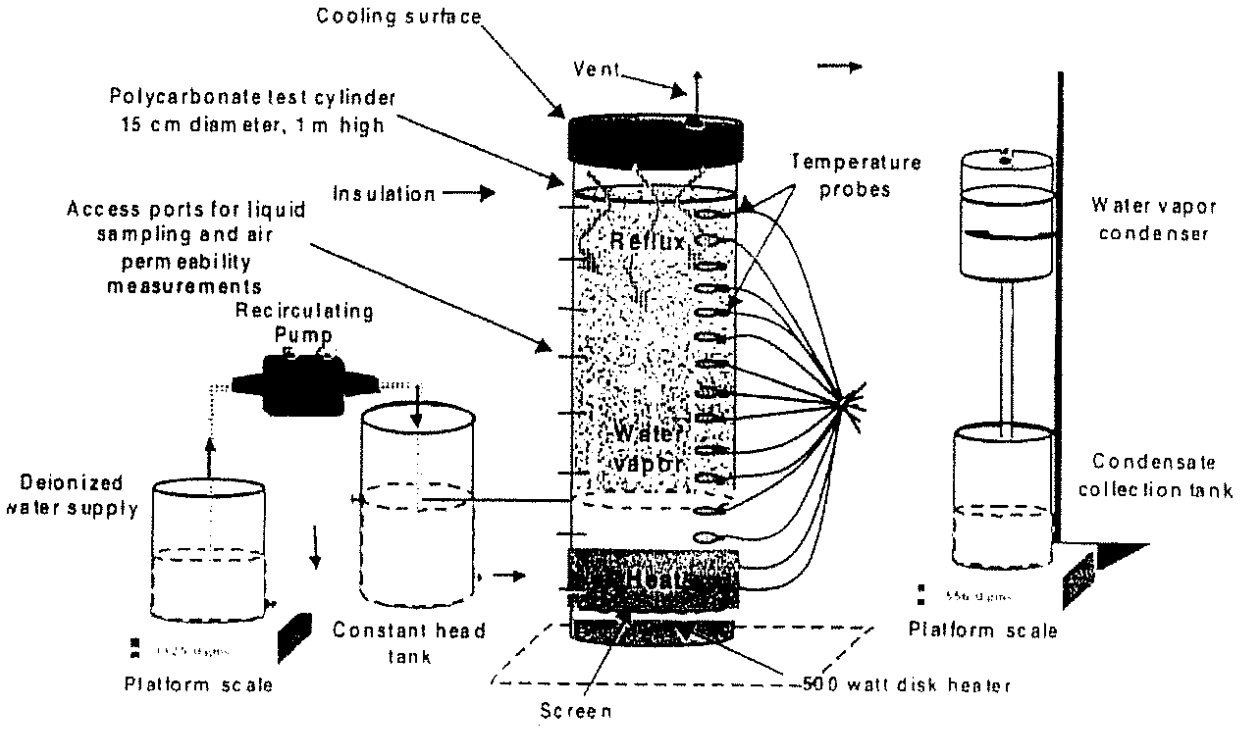
Not to Scale



Enclosure 5

Column Testing

Engineered Barrier Systems
Thermal/Hydraulic/Chemical Column Test



Enclosure 6