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

August 14, 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
Geosciences Section
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SUBJECT: U. S. NUCLEAR REGULATORY COMMISSION ON-SITE LICENSING REPRESENTATIVES' REPORT ON YUCCA MOUNTAIN PROJECT FOR MAY 1, 2000 THROUGH JUNE 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 May 1, 2000, through June 30, 2000.

This report highlights a number of Yucca Mountain Project activities of potential interest to NRC staff. The OR's continue to 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: Press Release on Fluid Inclusion Study
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-00-03

FOR THE REPORTING PERIOD OF MAY 1, 2000 THROUGH JUNE 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 99-1 : Suppliers not including appropriate technical or Quality Assurance (QA) requirements in nine subtier supplier's documents. Initially documented by the U.S. Nuclear Regulatory Commission (NRC) in the August/September 1999 On-Site Licensing Representative's (OR) Report.

A U.S. Department of Energy (DOE) surveillance confirmed the OR observation and DOE sent a letter to the nine affected suppliers. Subsequent to this letter, the DOE discovered 11 more suppliers with this problem. This increased the "defect rate" from 20% to more than 30%. 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 98-4: Technical data not always traceable to origin and the qualification status of the referenced data could not always be determined.

DOE issued Corrective Action Request (CAR) LVMO-99-001 on October 9, 1998. 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 QA issues 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 (DRs) to address the ineffectiveness of the Civilian Radioactive Waste Management System Management and Operating Contractor (M&O) to implement the processes established. Corrective action is still in process.

NRC OPEN ITEM (NEW) 00-2: Length of time to close Nonconformance Reports (NCRs)

The OR review of the NCR log indicates that some NCRs have remained open for almost four years. A similar NRC Open Item (98-1), initiated in January 1998, was reported closed (after more than 2 years) in the March/April 2000, OR Report. Timely closure of NCRs is an important outcome of any QA program. In the OR view, this topic should be discussed at the next DOE/NRC Management meeting.

Exploratory Studies Facility (ESF) & NRC Key Technical Issues

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

DOE continues efforts to maximize the amount of data available to support their Total System Performance Assessment - Site Recommendation (SR), Rev. 1. DOE has imposed a July 31, 2000, cut-off date for data to be considered in this document.

Seepage Testing

Seepage testing continues at various locations in the ESF and ECRB. According to DOE scientists, early results from testing in the Topopah Spring lower lithophysal zone indicate higher permeability and stronger capillarity as compared to the Topopah Spring middle nonlithophysal zone. This could potentially enhance the effectiveness of an open drift in the lower lithophysal zone as a seepage barrier. Additional testing is planned to verify these early results.

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 levels in this section of the ECRB to return to in-situ conditions to determine if dripping from the rock-mass can be observed. To date, in-situ moisture conditions have not been reached. DOE opened the bulkheads over this period to install drip indicators and conduct additional work in support of this test. Upon completion of this work, the bulkheads will be closed and testing will resume through CY 2000.

Cl-36 Validation Study

Testing to verify the presence of bomb pulse Chlorine-36 previously detected at the Sundance Fault and other locations continues. DOE reports that preliminary Tritium and Chlorine-36 analyses completed, to date, have not confirmed the presence of bomb pulse Chlorine-36; however, additional analyses await completion. Over this period, DOE initiated steps to determine if differences in sample preparation and processing techniques, used by two different laboratories, might explain differences in analytical results from these laboratories. An interim report on this study is presently expected to be completed by the end of CY 2000.

Thermal Testing

Over this period, DOE continued to reduce the power output to heaters to maintain drift wallrock temperatures below 200° Centigrade in the Alcove 5 thermal test. DOE is also proceeding with plans to conduct a new thermal test in the Topopah Spring lower lithophysal zone. DOE plans to start construction of this test facility in October 2000.

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 in Yucca Mountain rocks. Over this period, UNLV scientists hosted a meeting to discuss the status of this study. This study is presently expected to be completed in the Spring 2001 time frame.

Surface-Based Testing

Waste Handling Building Geotechnical Investigation

DOE has initiated a geotechnical investigation at the Yucca Mountain North Portal area to collect rock property and geophysical data for input to the design of a waste handling building for a potential repository at Yucca Mountain. The data collection portion of this work is expected to be completed over the Summer 2000 time frame.

Nye County Early Warning Drilling Program

Nye County continued their Phase II drilling program. Nye County completed drilling NCEWDP-7S and 19D over this period. In conjunction with a Nye County and DOE Cooperative Program, NC-EWDP-19D will be used for DOE's alluvial tracer testing. DOE plans to start alluvial tracer testing in August 2000. Nye County also plans to drill several deep wells to the carbonate aquifer beginning in July 2000.

Busted Butte Unsaturated Zone Transport Test Facility

Phase II tracer testing is expected to continue through FY-2000. DOE scientists report tracer breakthrough in collection holes from 10 and 50 ml/hr injection holes, but no breakthrough has been detected from 1 ml/hr injection boreholes. DOE is presently considering post test characterization options including overcoring selected injection boreholes, partial mine-back of the Phase II block, and sample analyses to better characterize tracer migration pathways. Over this period, Atomic Energy of Canada, LTD. (AECL), initiated radionuclide tracer testing on a block of tuff extracted from the Busted Butte Test Facility and transported to AECL's laboratory in Canada. Results of Busted Butte testing are to be documented in the unsaturated zone/saturated zone transport report.

Engineered Barrier System (EBS)Testing

EBS Test #4 (Drip Shield and Backfill) was completed over this period. A final report on this test is expected to be completed in September 2000. In August 2000, DOE plans to start a preclosure ventilation test at the EBS test facility. DOE has deferred column testing using crushed tuff pending the completion of supporting pre-test analyses and the allocation of additional funding to complete this testing. In the OR view, DOE should consider the benefits of proceeding with this testing until DOE has collected the data necessary to demonstrate the Thermal Hydrologic Coupled effects of flow from emplacement drifts are adequately characterized.

REPORT DETAILS

2.0 INTRODUCTION

The principal purpose of the OR report is to alert NRC staff, managers, and contractors to information on the DOE programs for site characterization, repository design, performance assessment, and environmental studies that may be of use in fulfilling NRC's role during prelicensing 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 May 1, 2000, through June 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 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.

NRC OPEN ITEM 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 U.S. Geological Survey). 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. The DOE Office of QA(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. This problem was initially reported by the OR in the August/September 1999 OR Report. DOE 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 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 Office of Civilian Radioactive Waste Management (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 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. A letter was issued three months later to the nine suppliers identified in the September/October 1999, OR report and not the entire suppliers listed on the QSL as the OR recommended to DOE.

During the March-April 2000, and May-June 2000 OR reporting periods, the OR reviewed the supplier audit/surveillance reports for the period of 11/99-5/00. The results of this review revealed there were 11 more instances where the DOE auditors discovered 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 total-up to 20 to date. Twelve conditions were noted during audits, three were from observations, and five were from surveys. Given there are about 60 suppliers on the QSL, the defect rate for this condition is in excess of 30% to substantiate this condition as being widespread and uncontrolled. DOE insists this condition has no impact on the product or service produced. However, the OR considers this condition to be significant 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. This issue has been elevated to NRC management for further attention. Consequently, this issue will continue to be carried as NRC Open Item 99-1.

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. 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, previously on a VAX system, has now been enhanced and placed on Lotus Notes. The SER is now retrievable through the Lotus Notes in conjunction with the applicable audit/surveillance report. The OR concludes that this revision is a significant improvement over the previous QSL. This observation pertaining to the QSL is now closed.

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 originally 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" required additional revisions 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 to June 30, 2000, and the M&O is presently in process of completing additional corrective actions in preparation for DOE verification.

(NEW) NRC OPEN ITEM 00-2 - LENGTH OF TIME TO CLOSE NCR REPORTS

The OR review of the DOE NCR log and tracking system runoff indicated an example of where an NCR has remained open up to almost four years and other examples of NCRs open more than two years. A similar NRC review (Open Item 98-1) of the CAR and DRs reported in the January/February 1998 OR Report, noted that these deficiencies remained open in excess of one year. This NRC Open Item was closed in the March/April 2000 OR Report noting significant improvements in timely closure of these types of deficiencies.

NCRs provide the vehicle for documenting nonconforming items, samples, and products both subject to and not subject to the requirements of the Office of Civilian Radioactive Waste Management Quality Assurance Requirements and Description document ("Q" and non-"Q"). It is recognized that certain NCRs may not have a high degree of safety significance. However, the large number of NCRs remaining open for extended periods of time, do not meet the full intent of the requirements of Title 10 of the Code of Federal Regulations (10 CFR), Part 60, Subpart G (which references 10 CFR Part 50, Appendix B). Criterion XVI of Appendix B requires in part, "...nonconformances are promptly identified and corrected."

This issue was briefly discussed with OQA representatives and it was noted that closing some of the issues are not of the utmost priority due to safety significance and budgetary constraints. The OQA personnel also noted that as of recent improved communication efforts, NCR closure times have improved.

The process for controlling the issuance and control of NCRs are delineated in Yucca Mountain Site Characterization Project Procedure YAP-15.1Q, "Control of Nonconformances." Unlike Administrative Procedure AP-16.1Q for activities subject to QA program controls, YAP-15.1Q does not provide specific requirements on establishing an agreed upon timely closure date and an extension date if necessary, by the involved responsible individuals for a particular deficiency. Also, unlike AP-16.1Q, YAP-15.1Q does not describe provisions which assign individuals to be accountable for closure.

YAP-15.1Q assigns the "responsible organization" for further action. The OR recommends that YAP-15Q be reviewed for possible improvements. It is also recommended that OQA elevate this matter to the next level of OCRWM management for timely resolution. This issue will be carried as a new NRC Open Item 00-2.

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 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. ECRB construction and testing activities are summarized below.

Passive Hydrologic Test:
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 moisture monitoring probes were previously placed in the tunnel walls at depths of up to 2 meters. While some test probes in this sealed off area show evidence of rewetting, DOE scientists state that moisture conditions in this section of the ECRB have not fully re-equilibrated.

Over this report period, DOE re-entered this area to initiate additional work in support of this test. This work includes: 1) the installation of drip indicators (pH treated cloth) and additional moisture monitoring instrumentation; 2) the installation of a third bulkhead between the Tunnel Boring Machine and Solitario Canyon Fault; 3) further characterization of organic material (mold) and; 4) the rewiring of lights in this section of the ECRB. This work is expected to be completed in several weeks. DOE currently plans to continue this test through CY 2000.

Niche #5:
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. The excavation of this niche was completed to a depth of approximately 30 meters. Niche walls and boreholes will be instrumented with moisture monitoring equipment, and a sealed bulkhead constructed at the entrance of this niche. Test results will feed the unsaturated zone flow and transport process model report.

Over this report period, DOE scientists completed initial air permeability and liquid release testing from radial boreholes in this niche. Liquid release testing facilitate the tracking of flow paths as the niche is excavated. See Systematic Hydrologic Characterization discussion below for early results of testing in the Topopah Spring lower lithophysal zone.

Systematic Hydrologic Characterization (SHC):
DOE scientists are conducting SHC testing to investigate the spatial variability of hydrologic properties affecting seepage processes induced by the introduction of large amounts of traced water at different distances above the ECRB drift. DOE is drilling a number of boreholes in the Topopah Spring lower lithophysal zone between Stations 14+44 and 17+63. The boreholes are used for air permeability and liquid release testing in percolation and seepage studies. Test results will feed the near-field and unsaturated zone flow and transport process model reports.

Over this report period, DOE scientists report that early results of SHC and niche seepage testing in the Topopah Spring lower lithophysal zone suggest the following preliminary implications:

- lower lithophysal tuff has over an order of magnitude higher permeability compared to the middle nonlithophysal tuff.
- seepage threshold may be significantly higher in the lower lithophysal tuff with capillarity stronger than in middle nonlithophysal tuff.
- seepage diversion may be more effective in the lower lithophysal tuff with higher permeability from small fractures connected by cavities.
- water may enter lithophysal cavities from below by capillary suction, providing a possible alternative explanation of calcite observed at the base of lithophysal cavities.

Alcove 8:
This alcove is being constructed at Station 8+00 to conduct seepage testing from the Topopah Spring upper lithophysal zone to the underlying Topopah Spring middle nonlithophysal zone.

Over this report period, DOE completed drilling a series of boreholes 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. An infiltration system will be constructed on the floor of Alcove 8 and traced water applied 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 has been constructed at the entrance of this alcove. Seepage testing is presently expected to start in the August 2000 time frame. Test results will feed near field and unsaturated zone flow and transport process model reports.

Cross Drift Drainage Benches:
Four of six planned drainage benches have been excavated for this testing. Drainage bench sites correspond to locations used in DOE's small scale fracture study. These 1 meter X 1 meter X 0.5 meter high benches are designed to characterize fracture properties for evaluation of seepage and drift drainage. A constant head infiltrometer (approximately 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 report period, testing continued at drainage benches located at Stations 17+35, 15+20, 11+15 and 13+00. Initial data analyses from this testing is expected to be submitted to DOE's Technical Data Management System by the end of FY 2000.

Cross Drift Thermal Test (CDTT):
Over this report period, DOE continued planning a thermal test in the Topopah Spring lower lithophysal zone at Station 16+95. A CDTT plan is expected to be completed in July 2000. DOE plans to start construction of the CDTT in October 2000. The heating phase of this test is presently expected to start in July 2001, and end in March 2002. A final test report is expected to be completed in FY-2003.

Exploratory Studies Facility (ESF) Testing

Moisture and post-construction monitoring continue. ESF testing activities are summarized below.

Chlorine-36 Validation Study:
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 elevated 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. A final report is presently expected to be completed by the end of CY 2001.

To date, this validation study has detected no elevated chlorine-36 values. According to DOE scientists, one possible explanation for the apparent disagreement between results of this study and an earlier study may lie in sample preparation and processing techniques. One of the two laboratories involved is thought to use a more aggressive crushing technique which may release more rock chloride thus reducing the ratio of chlorine-36 to chlorine. To determine the effect of two different sample preparation and processing techniques, a bulk sample has been collected from the ECRB and prepared for analyses. This sample will be split and shipped to the two labs involved in chlorine-36 studies for independent analyses. DOE will compare the results of these analyses to determine what effect sample preparation may have on chlorine-36 analyses.

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 June 21, 2000, approximately 646,472 liters (170,780 gallons) of water have been applied at the surface and approximately 115,731 liters (30,573 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 continued 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. DOE continues to monitor the tail-off in the concentration of lithium bromide traced water (presently approximately 72 parts per million) collected in Alcove 1. Data from this testing supports unsaturated zone infiltration, seepage, and transport models. This testing is expected to be completed in July 2000. A U.S. Geological Survey Open File Report on this testing is expected to be issued in the March 2001 time frame.

Over this report period, DOE scientists opened the bulkhead to this alcove for 12 days to evaluate the effect of ventilation on seepage. According to DOE scientists, ventilation resulted in an approximate 50 percent reduction in the rate of seepage. Upon closing the bulkhead, the seepage rate increased to levels observed before opening the 11 bulkhead. According to DOE scientists, preliminary qualitative analyses of this phase of testing suggest the following:

- 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.
- fractures dominate fluid flow, however tracer testing provides evidence for a small component of matrix diffusion.
- ventilation has a significant effect on seepage.

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 a downward 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 June 22, 2000, sensors in the heated drift recorded the following preliminary temperatures: canister temperature of 196.1° Centigrade (385° Fahrenheit), rock-mass

surface temperature of 192.2°Centigrade (378° Fahrenheit), and air temperature of 196.7° Centigrade (386° Fahrenheit).

Over this period, DOE scientists lowered the power output to heaters to maintain drift wall-rock temperatures below 200° Centigrade (392° Fahrenheit). DOE plans to hold these wall-rock temperatures for approximately 2 years to evaluate the effect of sustained heating on the hydrologic, chemical and mechanical behavior of the rock. Water and gas samples were collected from monitoring boreholes over this period.

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.

Over this report period, DOE opened the bulkheads to replace drip cloths used to detect any seepage in this alcove, and then closed the bulkheads. To date, DOE scientists report no seepage from the rock-mass in this alcove.

Niche #1 (35+66), Niche #2 (36+50), Niche #3 (31+07), and Niche #4 (47+87):
These niches have been excavated in the Topopah Spring middle nonlithophysal zone. 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.

Over this report period, UNLV scientists hosted a quarterly meeting and issued a press release (Enclosure 3) on the status of this study. This study is currently expected to be completed in the Spring 2001 time frame.

Laser Strainmeter Test:
Under a cooperative agreement with the Yucca Mountain Site Characterization Office, the University of California, Dan 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 Stations 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 4 shows the location of these wells. Nye County plans to drill 4 deep wells (12D, 15D, 2DB, 3DB) to the carbonate aquifer beginning in July 2000.

Over this report period, Nye County collected water samples from Phase I and II wells for hydrochemical analyses.

Alluvial Tracer Complex (ATC):
The ATC is a joint Nye County and DOE Cooperative Program to investigate flow and transport properties of the saturated alluvium and volcanic interface. The ATC test will be conducted at well NC-EWDP-19D and will consist of hydraulic and single well tracer injection testing in FY 2000.

Over this report period, Nye County drilled 19D to a depth of 1438 feet and encountered water at 366 feet and volcanic rocks at 810 feet. This well was completed to isolate seven water bearing zones (5 in alluvium and 2 in volcanic rocks). Nye County instrumented wells NC-EWDP-4PA, 4PB, 19P, 15P and Washburn to monitor ATC testing and completed a 48 hour pump test in 19D. DOE plans to initiate hydraulic testing in early July 2000, and tracer testing in August 2000.

Waste Handling Building Geotechnical Investigation:
Over this report period, DOE initiated 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 involves 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. DOE also plans to characterize near surface velocity over the potential repository using surface wave recordings generated by explosions in three boreholes on the crest of Yucca Mountain. This work is scheduled to be conducted over the Summer 2000 time frame.

Borehole Pneumatic Monitoring:
Pneumatic data recording and gas sampling continues at UZ-4/5 and NRG-7a; however, DOE plans to discontinue monitoring at NRG-7 in FY 2001. Nye County continues to record 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 14 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 presently expected to be completed in July 2000. DOE is presently considering post-test characterization options, including: overcoring selected injection boreholes, partial mine-back of the block, and rock sampling and analyses to better characterize the distribution of reactive and nonreactive tracers.

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. AECL started radionuclide tracer testing on a smaller block of tuff before initiating testing on the two larger blocks. On June 27, 2000, a representative from the Center for Nuclear Waste Regulatory Analyses visited AECL to observe the progress of this testing.

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. The U.S. Geological Survey 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, was completed over this report period.

The primary objective of this test was 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 natural fractures in the repository emplacement drifts. For this test, the surrogate EBS system consisted of a carbon steel cell (1.4 meters in diameters and 4 meters long). The test cell simulated the 5.5 meter diameter emplacement drift. Other components of the test included: a stainless steel drip shield; a carbon steel waste package, welded tuff invert; and Overton sand as backfill. The simulated waste package was 39 centimeters in diameter and 3.93 meters long. The decay heat from high-level waste was 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 continued to be drawn out of the test cell by lysimeters. This test was completed in May 2000, and a final test report is expected to be completed in the September 2000 time frame.

Pre-closure Ventilation Test:
DOE's System Design Description for the emplacement drift system states that the subsurface ventilation will remove 70 percent of the heat generated by the waste packages during pre-closure. Plans are underway to conduct a pre-closure ventilation test in the EBS test facility. The objectives of this test are to (1) develop data to support the design of the ventilation system for the potential repository to maintain sub-boiling emplacement drift temperatures; and (2) provide data to support computer models used for ventilation calculations. This testing is expected to start in August 2000, and conclude by the end of FY 2001.

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 purpose of this testing is to determine the potential changes in permeability due to Thermal Hydrologic Coupled (THC) effects in backfill/invert materials.

To date, three column tests have been initiated, however equipment and contamination difficulties have delayed the completion of this testing. It is the ORs understanding, that preliminary results of this testing suggest THC effects may result in a large decrease in the permeability of crushed tuff. Further testing has been deferred pending the completion of pre-test analyses and allocation of additional funding to complete this test. In the OR view, DOE should consider the benefits of proceeding with this testing until it has the necessary data to demonstrate the THC effects on flow out of emplacement drifts have been adequately characterized.

6.0 GENERAL

1. Appendix 7 Interactions: None

2. Other
   - On May 2, 2000, the ORs and two NRC Headquarters staff members met with the DOE Director of Institutional Affairs. The purpose of this meeting

was to obtain information and feedback from DOE's outreach and public meeting programs.

- On May 4, 2000, the ORs attended the NRC public meetings held in Las Vegas, NV, and Pahrump, NV. The purpose of these meetings was for NRC Headquarters personnel to explain the high-level waste licensing and inspection process for the potential repository.

- On May 29, 2000, and June 20, 2000, the OR's visited the Yucca Mountain facilities with NRC representatives from the NRC Region IV office in Arlington, TX. During these visits, several questions surfaced from the Region IV representatives regarding the potential use of shipping casks of nuclear waste versus utilizing a multipurpose cannister (MPC) should the Yucca Mountain Site ever be authorized as a geologic repository for the nation's commercial and defense spent nuclear fuel and high-level radioactive waste. This MPC would need to meet applicable regulatory design requirements for transportation and storage.

  The subject matter of these questions related to considering the exclusive use of an MPC instead of a cask containing individual assemblies that would need to have the assemblies removed one at a time, and then transported into a waste and disposal package. The rationale for this inquiry was that if an MPC was considered, it is projected that it would substantially reduce the potential risk for a fuel handling mishap, a costly fuel handling and repackaging facility, and reduce the need for extra resources. Should the potential geologic repository be constructed and licensed to dispose of nuclear waste, MPC's could be received directly and inserted into a waste package without the need to handle individual assemblies.

  A meeting/conference call was scheduled with the OR's and DOE Yucca Mountain and Headquarters personnel to obtain information for these inquiries. It was explained that DOE was directed to consider existing technologies in lieu of technology redevelopment and to include those technologies in the MPC design program to the maximum extent practicable. DOE intends to provide all parties with the most current information regarding the performance basis for canister disposability and waste package design. Consequently, DOE decided to cease development of specific MPC designs. While DOE continues to support the MPC concept, it believes it is in the nation's interest to also encourage the utilization of canisters for at-reactor storage that can be used for the Federal waste management system for transportation, storage, and disposal. This decision includes consideration for using NRC approved disposable canisters for the waste program. Part of the reasoning for this decision was to allow for compliance with regulatory requirements for disposal of a MPC that may remain uncertain until the potential for issuing a license for the monitored geologic repository actually occurs.

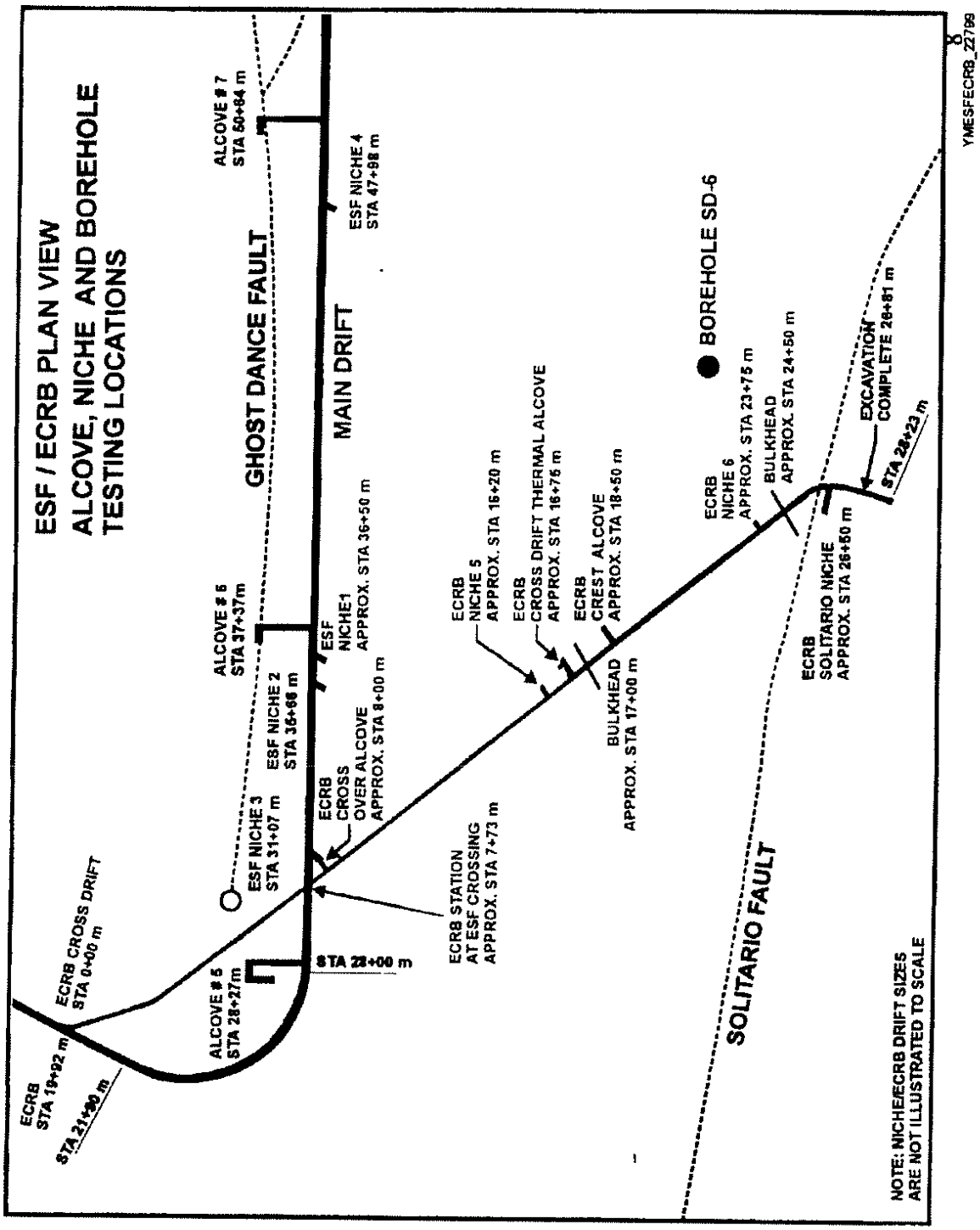
  At this meeting DOE also pointed out that certain of the defense and Navy waste are in MPC's. Also emphasized was that during the numerous nuclear

fuel handling operations at reactors, there has never been a fuel-handling accident that has resulted in off-site consequences.

- On May 30, 2000, the ORs attended the Nevada Commission on Nuclear Projects in the Clark County Commission Chambers, Las Vegas, NV. Presentations on the current status of their respective activities were given by representatives from NRC, DOE, Environmental Protection Agency, and the State of NV.

- On June 7, 2000, an OR attended a meeting of the Community Advisory Board for Nevada Test Site Programs in Amargosa Valley. Topics discussed in this meeting included the Nye County Early Warning Drilling Program, and the Nevada Test Site Underground Test Area Project and Off-site Groundwater Monitoring program.

- On June 14, 2000, the ORs met with the Quality Assurance Management Assessment team. The purpose of this meeting was to provide further explanation of Items documented in recent OR Reports.


ESF / ECRB PLAN VIEW
ALCOVE, NICHE AND BOREHOLE
TESTING LOCATIONS
GHOST DANCE FAULT
MAIN DRIFT
BOREHOLE SD-6
SOLITARIO FAULT
ECRB CROSS DRIFT STA 0+00 m
ECRB STA 19+92 m
STA 21+90 m
ALCOVE # 5 STA 28+27m
ESF NICHE 3 STA 31+07 m
ALCOVE # 6 STA 37+37m
ESF NICHE 2 STA 36+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
STA 22+00 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
ALCOVE # 7 STA 50+84 m
ESF NICHE 4 STA 47+98 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

Press Release

Yucca Mountain Fluid Inclusion Thermochronology Project

The Problem

Minerals in some openings in the volcanic rocks at the Yucca Mountain nuclear waste repository site contain small droplets of fluid known as fluid inclusions. These fluid inclusions record the passage of fluids through the minerals throughout geologic time and can be used to estimate the temperature of those fluids. If fluids with elevated temperatures moved through the rocks in the recent geologic past, they might do so again in the future, possibly posing problems if the fluids interact with nuclear waste.

Project Overview

The goals of this project include: 1) confirming *whether or not* fluids with elevated temperatures moved through the rocks in the geologic past, 2) if yes, determining the *temperatures* of these fluids, 3) determining the distribution of high temperature fluids throughout the repository site, and 4) determining *when* the fluids moved through the rock.

Progress to Date

We have examined 155 samples from throughout the repository site to determine formation conditions of the minerals that contain the fluid inclusions. We have analyzed fluid inclusions in about 40 samples and have identified the former passage of fluids with temperatures of about 45 to 60°C in most samples. A few samples record fluid temperatures of about 70 to 80°C. We emphasize that we have not determined the absolute time at which these fluids moved through the rocks, but the fluid inclusions are *not* in the very youngest minerals that precipitated.

Future Work

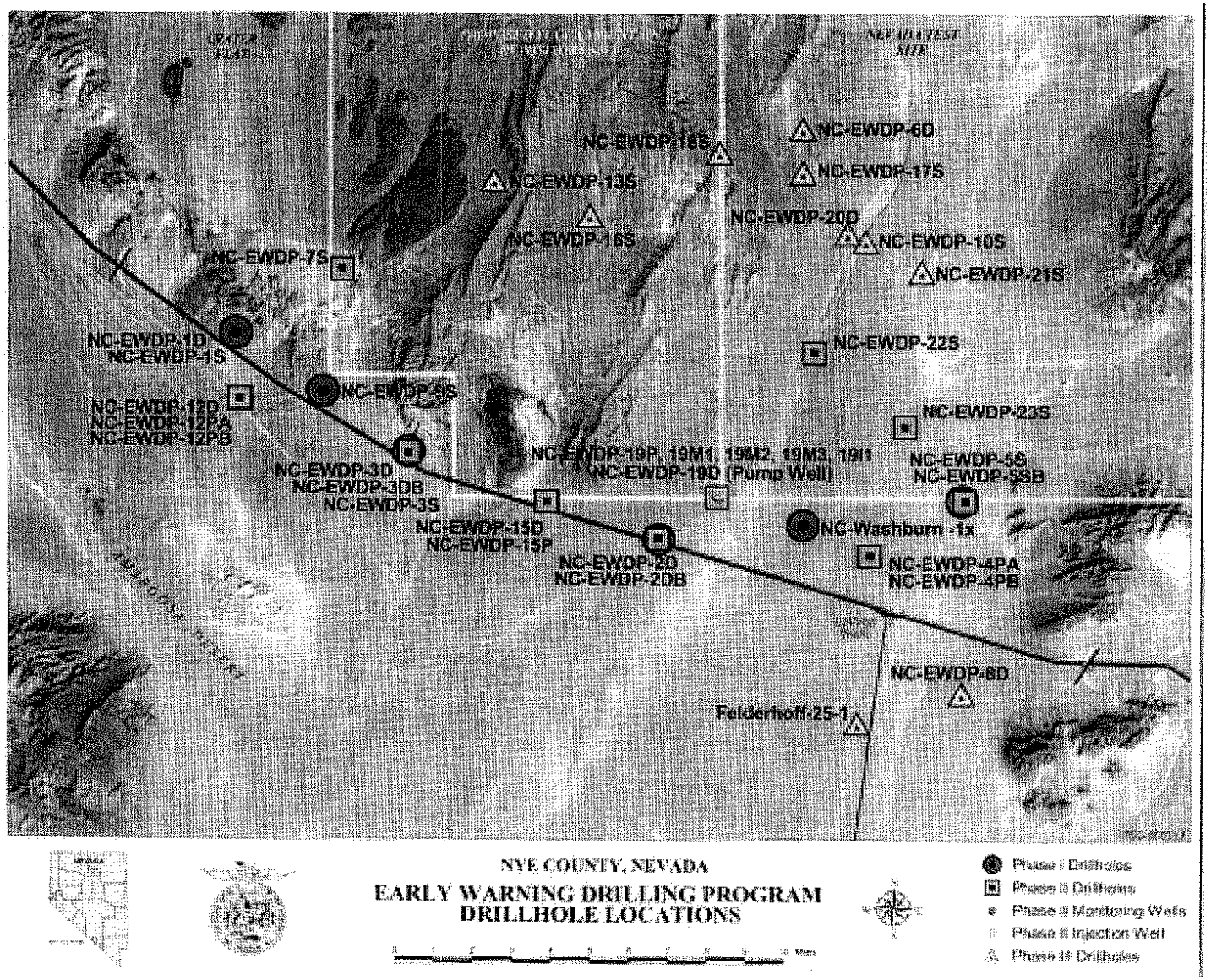
Future work will include studies to constrain the absolute ages of the fluid inclusions and the timing of fluid movement through the rocks. We will also collect additional fluid inclusion temperatures and will continue to refine the growth history of the samples.

Personnel

This project is being conducted by Dr. Jean S. Cline, Associate Professor, Dr. Nicholas Wilson, post-doctorate fellow, Sarah Lundburg, microbeam analyst, and Joel Rotert, graduate student, University of Nevada, Las Vegas. Participating in project oversight and/or conducting parallel studies are: Dr. Robert Bodnar, Virginia Tech, Dr. Yuri Dublyansky, Siberian Branch of the Russian Academy of Sciences, Dr. Edwin Roedder, Harvard University, and Dr. Joe Whelan, US Geological Survey.

Enclosure 3

Enclosure 4


NC-EWDP-16S
NC-EWDP-6D
NC-EWDP-13S
NC-EWDP-17S
NC-EWDP-20D
NC-EWDP-18S
NC-EWDP-10S
NC-EWDP-7S
NC-EWDP-21S
NC-EWDP-1D
NC-EWDP-1S
NC-EWDP-22S
NC-EWDP-9S
NC-EWDP-12D
NC-EWDP-12PA
NC-EWDP-12PB
NC-EWDP-23S
NC-EWDP-19P, 19M1, 19M2, 19M3, 19I1
NC-EWDP-19D (Pump Well)
NC-EWDP-5S
NC-EWDP-5SB
NC-EWDP-3D
NC-EWDP-3DB
NC-EWDP-3S
NC-Washburn -1x
NC-EWDP-15D
NC-EWDP-15P
NC-EWDP-2D
NC-EWDP-2DB
NC-EWDP-4PA
NC-EWDP-4PB
NC-EWDP-8D
Felderhoff-25-1
NYE COUNTY, NEVADA
EARLY WARNING DRILLING PROGRAM
DRILLHOLE LOCATIONS
Phase I Drillholes
Phase II Drillholes
Phase II Monitoring Wells
Phase II Injection Well
Phase III Drillholes