February 23, 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
Projects and Engineering Section
Division of Waste Management
Office of Nuclear Material Safety and Safeguards

Chad J. Glenn, Sr. On-Site Licensing Representative
Projects and Engineering Section
Division of Waste Management
Office of Nuclear Material Safety and Safeguards

SUBJECT: U. S. NUCLEAR REGULATORY COMMISSION ON-SITE LICENSING REPRESENTATIVES' REPORT ON YUCCA MOUNTAIN PROJECT FOR OCTOBER 1, 1999 THROUGH DECEMBER 31, 1999.

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 October 1, 1999 through December 31, 1999.

Due to the holiday season and vacation schedules, for reporting purposes, this report will be a combined report for the months of October - December 1999.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 continue 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: U.S. Nuclear Regulatory Commission On-Site Licensing Representatives Report
ESF/ECRB Plan View/Alcove, Niche, & Borehole Testing Locations
Systematic Characterization of Topopah Spring Lower Lithophysal Unit
Press Release/Yucca Mountain Fluid Inclusion Thermochronology Project

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U.S. NUCLEAR REGULATORY COMMISSION
ON-SITE LICENSING REPRESENTATIVE REPORT
NUMBER OR-99-06

REPORT DETAILS

1.0 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 October 1, 1999, through December 31, 1999.

2.0 OBJECTIVES

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

3.0 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 indicate 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 started in November 1999 and is presently continuing through January 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. Current status is reported below.

97-2 PROCUREMENT/DATA QUALIFICATION

(Ref: DOE CARS LVMO-98-C-002 (Data Qualification), and VAMO-98-C-005, 2, (Procurement).

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 licensing. CAR LVMO-98-C-002 was issued and all data obtained by the M&O and USGS suppliers were identified and are 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 Site Recommendation Considerations Report (SR) or License Application (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 process would need to be evaluated to gain confidence that the process is being effectively implemented. The DOE QA organization has determined that verification will extend to at least the audit of the UZ Flow and Transport PMR scheduled for 01/24/00. It will be decided then, whether or not sufficient data verification/qualification activities have taken place to support closure.

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 document. Also required was 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.

99-1 QA/TECHNICAL REQUIREMENTS NOT INCORPORATED

The OR review of supplier audit/surveillance reports during the period of March - October 1999, indicated there were additional problems in 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 is being drafted at this time. The NRC OR has requested to be placed on distribution for this letter should it be issued. Also, in the future, the DOE trending program should notify appropriate managment 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 for not appropriately incorporating technical and QA requirements. At the December 16, 1999 DOE/NRC Management/Quality Assurance meeting, DOE reported that several supplier deficiencies in this area have already been closed and there was no impact to work performed. 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 have 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 categorized open deficiencies in their order of priority to close these deficiencies in a more timely manner in 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." Beginning June 1, 1999, all deficiencies open in excess of one year will be elevated to the DOE OCRWM Director.

The January 1999, DOE trending deficiency list noted there were 81 open deficiencies with several being open in excess of two years. Since January 1999, over 85 more deficiencies have been initiated. Presently, there are seven deficiencies open more than 365 days and a total of 35 open deficiencies.

In the December 1999 DOE/NRC meeting, the M&O summarized the program's recent experience with Corrective Action performance. The M&O cited a reducing number of deficiencies and reduction in the length of time it takes to close a deficiency. Since inception of the revised process for managing conditions adverse to quality, the number of deficiencies closed within the first 100 days of the revised procedure more than doubled as compared to the same time frame a year earlier. This information supports improvement in the length of time to close deficiencies.

The OR attends the weekly CAB meetings on a regular basis, to observe the progress in the closure of deficiencies in order to gain confidence to close NRC Open Item 98-1. CAB members are very proactive and are instrumental and extremely effective in expediting closure of the many open deficiencies, especially those open for extended periods of time. It appears that there is an effective process in place to track and close open deficiencies in a timely manner. There also has been an increased level of accountability from both the M&O and DOE management staff responsible for deficiency resolution. The OR will monitor this process and if it continues to be effective, NRC Open Item 98-1 could be closed in the next OR Report time frame.

98-2 SCIENTIFIC NOTEBOOKS

OR observations of DOE audits and surveillances indicated an increased pattern or trend in scientific notebook (SN) deficiencies. The deficiencies pertaining to SNs were evaluated to determine the extent of the appropriate corrective action and extent of required training. Administrative Procedure AP-SIII.1Q, "Scientific Notebooks," was revised and was effective 6/30/99. DOE stationed an On-Site Representative at each of the participant's facilities to assist in SN reviews and development

In lieu of initiating a CAR, a plan was established and customized to train each participant organization in the use and control of SNs. Also, a compliance criterion checklist was prepared to review all active SNs. These actions were completed by March 31, 1999. In conjunction with CAR LVMO-98-C-002, "closed" SNs to be used for SR or LA will be reviewed in accordance with the above checklist. Inactive or completed SNs will be reviewed to determine the extent of further reviews based on the need to use this information for SR or LA.

Reviews of 656 open SNs have been completed and presently, all comments have been resolved. There are 547 remaining "closed" SNs that will require reviews should any of these 547 SNs be used for SR or LA.

Based on several actions--the reviews that have been completed to date, training, NRC and DOE staff feedback from audits and task force efforts, and no new deficiencies being initiated--it appears that the problems with SNs have been corrected. An effective process is now in place to control SN review. Therefore, based on the above, NRC Open Item 98-2 is closed.

98-3 MODEL DEFICIENCIES

(Ref: CAR-LVMO-98-C-010)

The M&O line organization performed two vertical slice reviews late 1997 and early 1998. Conclusions documented in the M&O's reports from the review of the Site-Scale

Unsaturated Zone Flow Model and the Total System Performance -1995 for Waste Form Degradation and Solubility Limits indicate 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. A correlation plan of the vertical slice findings/issues to the procedure development and corrective action program was initiated to delineate how and where the vertical findings are being resolved. This plan (R. Howard to D. Wilkins dated 7/6/99) was furnished to the OR and to the NRC HQ staff.

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. This will initiate the development of a proceduralized process for analyses and models (AP-3-10Q). The extent of this determination will result from the "Tiger Team" investigation. The OR's will monitor the progress/improvements resulting from this action plan which was 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 is now scheduled for late January 2000.

98-4 TRACEABILITY

(Ref: CAR LVMO-99-C-001)

As a result of the October 1998, DOE performance-based audit of the M&O, a significant condition adverse to quality was documented on CAR LVMO-99-C-001. This CAR 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 has been rescheduled for 1/24/00.

TRENDING PROGRAM RECOMMENDATION

Deficiencies that are identical to an existing open CAR or Deficiency Report (DR) are documented on a Deficiency Identification and Referral (DIR) form. The DIRs are then added to the existing CAR/DR package and require resolution in conjunction with the existing CAR/DR resolution. The responsible organization receiving the CAR/DR, must determine the entire population affected by the deficiency and not limit the corrective action to the CAR/DR and DIRs.

The DIR process; however, can in some instances provide an indication if the deficient condition is widespread. DIRs are dated and entered into the tracking system only as part of the deficiency to which they relate. The current process may not provide needed visibility for individual tracking. Therefore, the OR recommends that DOE consider revising AP-16.1Q to include provisions to provide unique identification for each DIR issue and enter the identifier into the data base for tracking purposes.

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

Enhanced Characterization of the Repository Block (ECRB)

DOE continues to accelerate their ECRB construction and testing activities to maximize the amount of data available to support DOE Total System Performance Assessment (TSPA) - Site Recommendation, Rev.1. The proposed cut off date for data to be considered for this revision is July 31, 2000. Enclosure 1 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. According to DOE scientists, water potential measurements from heat-dissipation probes installed in 2 meter deep boreholes at 25 meter intervals, indicate the rock-mass is wetter then predicted; however, measurements vary with lithology.

Passive Hydrologic Test (17+63 - 28+23):
Two sections of the ECRB have been isolated from the rest of the underground facility by the construction of sealed bulkheads. One is located about half-way into the ECRB and the other is near the western end just east of the Solitario Canyon Fault. 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. Hundreds of heat dissipation probes were previously placed in the tunnel walls at depths of up to 2 meters. Test probes in the isolated area that had previously shown evidence of rock drying under ventilation now 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 perform 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. On August 31, 1999, the bulkheads were opened for several days and DOE scientists observed no evidence of moisture. DOE plans to open the bulkheads again in January 2000.

NRC hydrologists have expressed interest in entering isolated parts of the ECRB under unventilated conditions to observe first-hand whether natural dripping of water occurs when the tunnel is at ambient conditions. DOE staff have proposed an alternative approach to obtain evidence of moisture or dripping water in the ECRB. DOE has proposed that drip indicators (pH treated cloth) be installed in the sealed-off portion of the ECRB. This would preclude the need for scientists to use self-contained breathing apparatus to enter unventilated underground facilities to physically observe moisture or dripping water. NRC hydrologists have expressed support for this approach. DOE scientists expect the sealed portion of the ECRB to achieve its natural state of saturation around the April 2000 time frame. DOE's proposal calls for the installation of the drip indicators at that time; however, funding for this proposal has not yet been approved. DOE currently plans to keep this portion of the ECRB sealed 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. Three 20 meter deep boreholes have been drilled parallel and adjacent to the planned niche location and pre-excavation air permeability testing completed. These boreholes are used to conduct air permeability testing to monitor pre- and post-excavation effects. This niche will be excavated to a depth of approximately 30 meters using an Alpine Miner (mechanical excavation technique). The 14 meter access drift was excavated over this reporting period. In the weeks ahead, DOE will drill additional boreholes at the end of this access drift for air permeability and liquid release testing. After this testing, constructors will extend the excavation 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. Initial seepage testing is expected to start by late February 2000. Test results will feed 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 using a combination of drill and blast, and mechanical excavation techniques. To date, this excavation has advanced approximately 3 meters via drill and blast. In January 2000, excavation will resume using the Alpine Miner. 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 will be 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 (approximately 2-centimeters/day). 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

April-May 2000 time frame. Test results will feed 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. A series of 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. The proposed configuration of these boreholes is illustrated in Enclosure 2. This drilling and testing activity is expected to start in February 2000. Test results will feed the unsaturated zone flow and transport process model report.

Exploratory Studies Facility (ESF) 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 at two locations in the ESF. DOE scientists completed the collection of approximately 50 samples in the vicinity of the Drill Hole Wash Fault and the Sundance Fault where anomalously high concentrations of chlorine-36 were detected in a previous study. These samples will be analyzed for chlorine-36, tritium, technetium-99, and supplemented by analyses of uranium, thorium, iodide-129 and radium isotopes. A final report on this study is presently expected to be submitted to DOE in April 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 December 31, 1999, approximately 348,114 liters (91,962 gallons) of water have been applied at the surface and approximately 54,203 liters (14,319 gallons) collected in Alcove 1. Initial breakthrough of traced water occurred on March 6, 1999.

Since October 1999, DOE scientists have been conducting their final infiltration experiment at Alcove 1. Lithium bromide traced water has been 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. Project scientists believe breakthrough of this tracer occurred on approximately November 25, 1999. Concentration of lithium bromide traced water collected continues to build (presently ~ 160 parts per million). Scientists plan to continue this experiment until they see a tail-off of concentration in traced water. Preliminary qualitative analysis of this experiment indicate that when steady-state flow conditions are established, the travel time from the land surface to the alcove (distance of 32 meters) is approximately three to four weeks. Data from this testing will serve as input to a report on unsaturated zone model validation activities which is scheduled to be completed in January 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.

Alcove 3:
Over this reporting period, there were no new activities conducted in Alcove 3.

Alcove 4.
DOE scientists resumed fracture-matrix testing in the Paintbrush nonwelded unit over this reporting period.

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 heat-up 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 December 31, 1999, sensors in the heated drift recorded the following preliminary temperatures: canister temperature of 193.3° Centigrade (380° Fahrenheit); rock-mass surface temperature of 186.7° Centigrade (368° Fahrenheit); and air temperature of 191.7° Centigrade (377° Fahrenheit).

Over this reporting period, two Drift Scale Test boreholes (Boreholes # 56 and 73) were converted from chemistry to hydrology holes. DOE conducted a thermal test workshop in Albuquerque, New Mexico in November 1999. Thermal Test Progress Report #4 was also completed over this period.

In December 1999, in response to a request from the Center for Nuclear Waste Regulatory Analyses (CNWRA), DOE shipped bulk rock samples from the potential repository horizon Topopah Spring Lower lithophysal unit to CNWRA facilities in San Antonio, Texas. NRC's contractor plans to use these samples in a lab-scale heater test.

Alcove 6 (Northern Ghost Dance Fault Alcove):
Over this reporting period, there was no new testing conducted in this alcove. Testing in this alcove was designed to investigate the hydrochemical and pneumatic properties of the Ghost Dance Fault. Excavation of this alcove cut the fault at station 1+52. At this location, the fault is approximately one meter wide with a vertical offset of six meters. Scientists completed their field investigations in December 1998. A report (Milestone SP3515M3) documenting the results of this testing was completed over this reporting period.

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 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 expect to enter this alcove in late January 2000 to download data.

Niche #1 (35+66):
The steel bulkhead for this niche was closed in January 1998, to monitor in-situ moisture conditions. Data continues to be collected from instruments that monitor humidity, moisture, and rewetting of niche walls.

Niche #2 (36+50), Niche #3 (31+07), and Niche #4 (47+87):
These niches have been excavated and bulkheads constructed at the entrance of each niche. In 1998, investigators completed drift seepage threshold testing in Niche #2. Over this reporting period, DOE scientists completed water release tests at Niche #3, and initiated testing in Niche #4 to quantify seepage into drifts.

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 is currently conducting petrographic analysis of samples collected from the ESF and ECRB to determine the sequence of mineral precipitation in these samples. The presence of fluid inclusions in these samples is also noted in these analyses. Microscopic fluid inclusions can yield information about minimum fluid temperatures at the time of their formation. Rock samples containing these fluid inclusions will be dated to constrain the age of the inclusions. On November 9, 1999, UNLV issued a press release on the status of this study (Enclosure 3).

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

- long-term tectonic changes
- earth tides
- barometric pressure changes
- static deformations caused by local earthquakes
- construction of potential repository

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. Three of four instrument boreholes were drilled over this period. Data collection is expected to start over the summer of 2000 and continue for a period in excess of 10 years.

Surface-Based Testing

Nye County Drilling and Testing:
The start of the second phase of the Nye County drilling and testing program has been delayed pending resolution of an issue related to the pay scale for drillers. This drilling is now expected to start in January 2000.

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

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. If these results are substantiated, they may provide the basis for significantly longer travel times in the Calico Hills Formation.

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 is expected to continue through CY 1999. 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. Results of this testing will be documented in a report on unsaturated zone/saturated zone transport properties, which is expected to be completed by January 2000. In February 2000, DOE presently plans to stop tracer injection and core approximately 20 boreholes to establish the extent of tracer migration.

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.

Engineered Barrier System (EBS) Testing:

The Engineered Barrier System Operations (EBSO) Office of the Yucca Mountain Project continues to perform EBS testing. The EBS tests are performed in a Pilot Scale Test Facility located in North Las Vegas. USGS also supports the EBS tests providing hydrologic properties of the test materials and instruments such as heat dissipation probes, lysimeters and data loggers. Test results feed the EBS degradation and transport process model report.

Pilot Scale Testing

EBS Test #3, Drip Shield Test:
During this period, this test was terminated. Post-test related activities are in progress. Visual inspection of the waste package surface and the surface below the drip shield did not show any indication of moisture.

EBS Test #4, Drip Shield and Backfill:
Invert material (crushed tuff) has been placed in the quarter scale test cell. In December 1999, the first phase of the test started. It consists of determining the response of the test system to heat. The test will then evaluate the response of the system with drip shield, backfill, and dripping water. The backfill for this test will be Overton sand.

The primary objective of Test #4 is to demonstrate the movement of the moisture (water dripping from the roof of the emplacement drift) on the backfill and how it moves through the backfill and is removed by the natural fractures in the repository emplacement drifts. For this test, the surrogate EBS system consists of a carbon steel cell (1.4 meters in diameters and 4 meters long) The test cell simulates the 5.5 meter diameter emplacement drift. 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 (drift wall) temperatures.

EBS Test #5, Drip Shield and Backfill:
Test #5 is being planned. This test will be the same as Test #4 except the backfill will be 4/10 silica sand.

EBS Test #6, Drip Shield with no Backfill:
This test is in planning. Test cell for this test is being prepared. This test is being planned to assess the impact of slightly above boiling temperature in the invert as compared to the 80° Centigrade (176° Fahrenheit) for the EBS Test #3. The waste package temperature will be 100 - 105° Centigrade (212 - 221° Fahrenheit).

Column Test #1:
In December 1999, DOE started aThermal-Hydrological-Chemical (THC) column test using crushed tuff. This test is designed to replicate a previously reported test by Rimstidt (Rimstidt and Williamson 1991). The expected duration of this test is between 4-6 weeks. The goals of the column testing are to: 1) compare THC effects in different materials, e.g. crushed tuff, quartz sand, or limestone; 2) characterize THC coupled processes that could affect drip shield performance; 3) analyze the composition of fluid that reenters the backfill after heating, and re-mobilizes the precipitates; and 4) generate data for validating THC predictive models which will support the EBS PMR, Rev. 01.

Laboratory Testing
EBSO has been working to establish a facility to support limited laboratory work. This facility will allow the acquisition of qualified data such as particle size, thermal conductivity of the test materials, moisture content, densities, and other soil properties required by various EBSO deliverables.

5.0 GENERAL

1. Appendix 7 Interactions

October 18, 1999, two representatives of NRC Divisions of Waste Management visited the Yucca Mountain site.

October 27, 1999, the Director of the NRC Office of Nuclear Material Safety and Safeguards, and OR's visited the Yucca Mountain Site.

October 28, 1999, the Director of the NRC Office of Nuclear Material Safety and Safeguards met with representatives from DOE, State of Nevada, Affected Units of Government, and other interested parties for the proposed high-level waste repository.

November 10, 1999, two representatives of NRC Spent Fuel Project Office and Division of Waste Management visited the Yucca Mountain site.

The purpose of these visits were to obtain an overview of DOE's site characterization activities. There were no outstanding issues raised as a result of these visits.

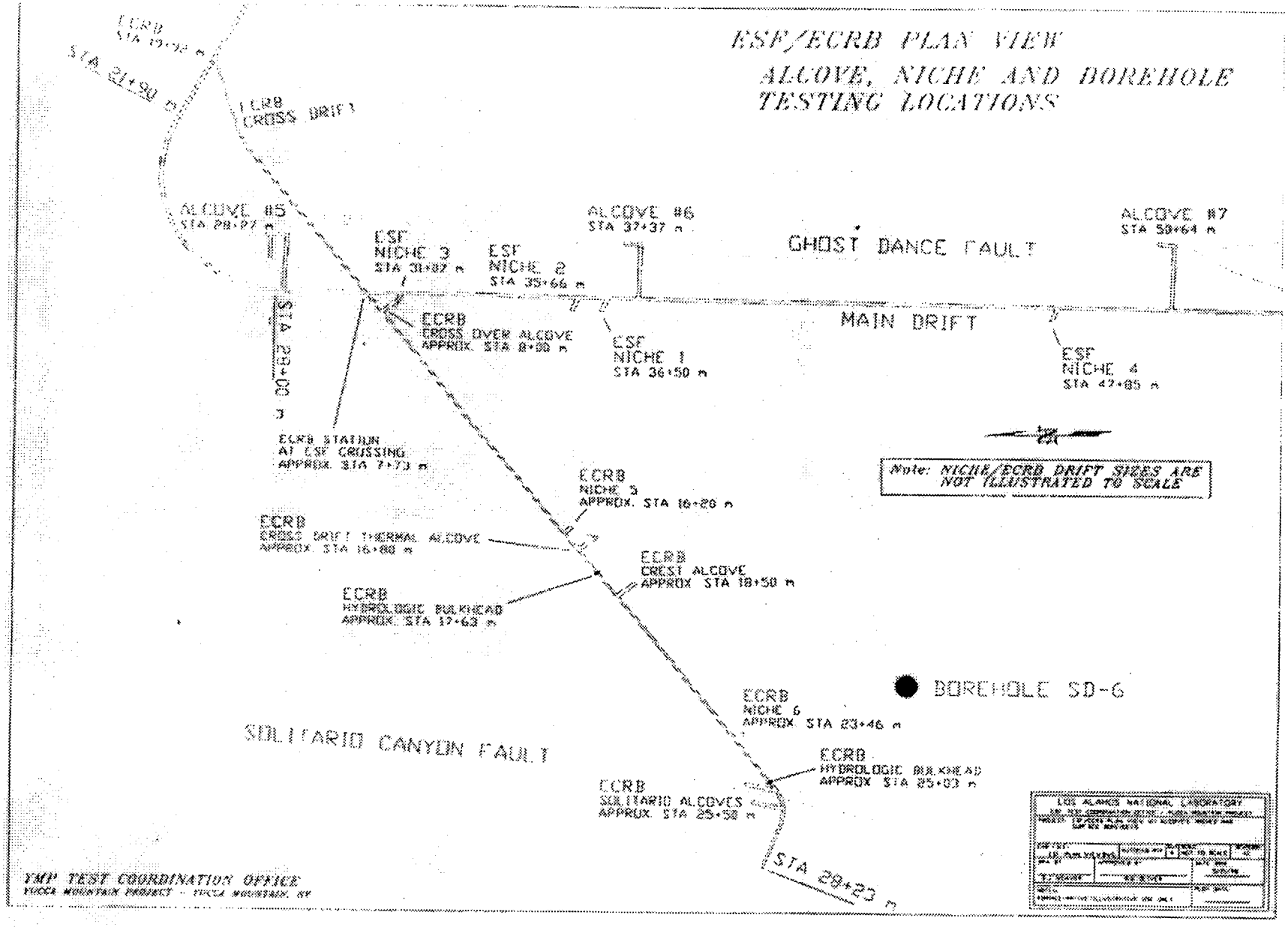
2. Other

October 25, 1999, the OR's participated in a conference call with the Director of the Division of Waste Management and members of the Quality Assurance Management Assessment (QAMA) team to discuss the recently issued QAMA Report.

November 2, 1999, the OR's attended the NRC Round Table Discussion on Defense In Depth as applied to a possible high-level waste repository at Yucca Mountain, Nevada. This discussion was held in Las Vegas, NV.

December 1-2, 1999, the OR's attended public meetings on DOE's Draft Environmental Impact Statement in Reno and Carson City, Nevada.

December 8, 1999, the OR's attended NRC's Spent Fuel Project Office public meeting on its transportation modal study. The meeting was held in Henderson, Nevada.


ESF/ECRB PLAN VIEW
ALCOVE, NICHE AND BOREHOLE
TESTING LOCATIONS
ECRB
CROSS DRIFT
ALCOVE #5
STA 28+27 m
ALCOVE #6
STA 37+37 m
ALCOVE #7
STA 59+64 m
ESF
NICHE 3
STA 31+87 m
ESF
NICHE 2
STA 35+66 m
GHOST DANCE FAULT
MAIN DRIFT
ECRB
CROSS OVER ALCOVE
APPROX. STA 8+00 m
ESF
NICHE 1
STA 36+50 m
ESF
NICHE 4
STA 42+85 m
STA 20+00
ECRB STATION
AT ESF CROSSING
APPROX. STA 7+73 m
Note: NICHE/ECRB DRIFT SIZES ARE
NOT ILLUSTRATED TO SCALE
ECRB
NICHE 5
APPROX. STA 16+20 m
ECRB
CROSS DRIFT THERMAL ALCOVE
APPROX. STA 16+80 m
ECRB
CREST ALCOVE
APPROX. STA 18+50 m
ECRB
HYDROLOGIC BULKHEAD
APPROX. STA 17+63 m
BOREHOLE SD-6
ECRB
NICHE 6
APPROX. STA 23+46 m
ECRB
HYDROLOGIC BULKHEAD
APPROX. STA 25+03 m
SOLITARIO CANYON FAULT
ECRB
SOLITARIO ALCOVES
APPROX. STA 25+58 m
STA 29+23 m
YMP TEST COORDINATION OFFICE

Enclosure 1

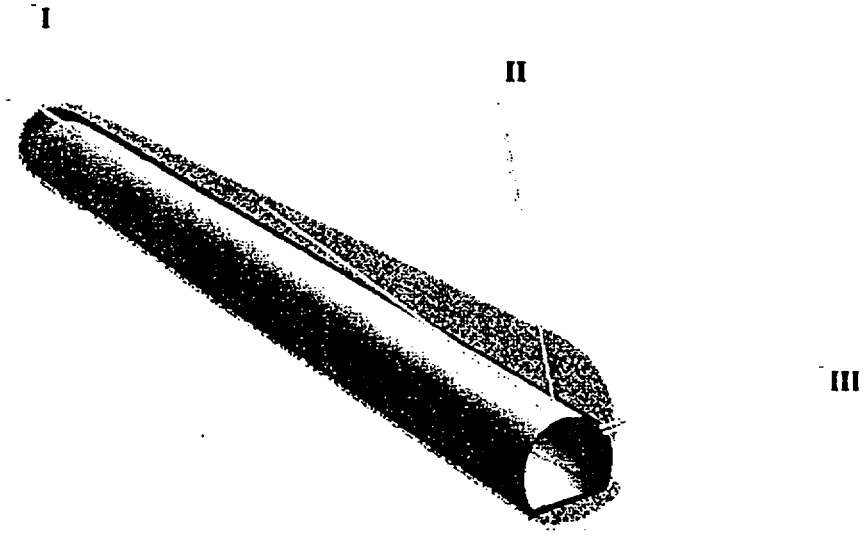
Systematic Characterization of Topopah Spring Lower Lithophysal Unit

Three Categories of ~20 meter long boreholes for performing air permeability, liquid seepage and gas tracer tests

I One low angle (~15° from drift axis), every 30 meters along ECRB Cross Drift

II One near vertical (~75° from drift axis), every 90 meters along Cross Drift

III One horizontal pair (2 to 3 meter separation) collared on rib, every 90 meters along Cross Drift



Enclosure 2 Categories of boreholes between Stations 14+44 and 17+63 for systematic characterization of flow and transport properties of the Topopah Spring lower lithophysal unit

1/9/99

Press Release

Yucca Mountain Fluid Inclusion Thermochronology Project

The Problem

Minerals are present in some openings in volcanic rocks at the Yucca Mountain nuclear waste repository site. During mineral formation, tiny packages of watery fluid moved through fractures in the rock and were trapped as fluid inclusions. Some of this fluid had temperatures higher than temperatures at Yucca Mountain today. If these higher temperature fluids moved through the rocks in the recent geologic past, there is the possibility that higher than normal temperature fluids could flow through these rocks again in the future. This could pose problems if the fluids interacted with nuclear waste. If these fluids moved through the rocks in the more distant geologic past, and the high temperatures were associated with the original volcanic activity that formed Yucca Mountain, there may be less potential for fluids to move through the rocks in the future.

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) determining the temperatures of these fluids, and 3) and determining when these fluids moved through the rocks.

Progress to Date

We have collected 150 samples from throughout the proposed repository site. We have had thin slices of rock cut from these samples and we are now studying these slices (thin sections) under the microscope to learn how the minerals "grew" and to locate and describe the fluid inclusions.

Conclusions to Date

We now have a good understanding of how the minerals "grew" in the open spaces in the rock. We have also confirmed that watery fluids with elevated temperatures moved through the rocks at some unknown time in the geologic past. *We do not yet know the temperature of this fluid, the time the fluid moved through the rocks, or whether the fluid rose from depth or descended from the surface.*

Future Work

Future work will include analyzing the fluid inclusions to determine the temperatures of the fluids that moved through the rocks, and we will determine the age of

U. S. NUCLEAR REGULATORY COMMISSION

ON-SITE LICENSING REPRESENTATIVES REPORT

NUMBER OR-99-06

FOR THE REPORTING PERIOD OF OCTOBER 1, 1999 THROUGH DECEMBER 31, 1999

1/19/00

William L. Belke
Sr. On-Site Licensing
Representative
Projects and Engineering
Branch Section
Division of Waste Management

Chad J. Glenn 1/19/00

Chad J. Glenn
Sr. On-Site Licensing
Representative
Projects and Engineering
Branch Section
Division of Waste Management

Reviewed and approved by: for 2/23/00

Newton K. Stablein
Section Leader
Projects and Engineering
Branch Section
Division of Waste Management

Enclosure

the minerals containing the higher temperature fluids.

Personnel

This project is being conducted by Dr. Jean S. Cline, Associate Professor, and Dr. Nicholas Wilson, post-doctorate fellow, at the University of Nevada, Las Vegas. Participating in the project in oversight capacity are: Dr. Robert Bodnar, Virginia Tech, Dr. Yuri Dublyansky, Siberian Branch of the Russian Academy of Sciences (representing the State of Nevada), and Dr. Edwin Roedder, Harvard and Dr. Joe Whalen, US Geological Survey (representing DOE).