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Date: February 7, 2003  
Refer to: RRES-WQH: 03-031

Mr. Wayne Price  
Petroleum Engineering Specialist  
Oil Conservation Division  
New Mexico Energy, Minerals and Natural Resources Department  
1220 South St. Francis Drive  
Santa Fe, New Mexico 87505

**SUBJECT: PROGRESS REPORT AND PROPOSED BACKFILL PLAN, 1-MG SERVICE POND, FENTON HILL GEOTHERMAL FACILITY**

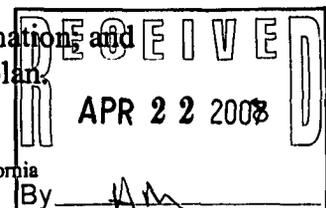
Dear Mr. Price:

As you are aware, since October 2002, Los Alamos National Laboratory has been in the process of closing the Fenton Hill Hot Dry Rock Geothermal Facility's 1-million gallon (MG) service pond. After making significant progress, the Laboratory is entering the final stages of closure. I would like to provide you with a progress report on the work completed to-date. In addition, this letter presents the Laboratory's proposed plan for backfilling the pond for your review and approval. Progress report information is contained within Section I while the proposed backfill plan is presented in Section II.

**Section I-Progress Report**

In accordance with the requirements of the Laboratory's Closure Plan for the Fenton Hill 1-MG Service Pond (LA-UR-02-5009, August 2002), closure activities to-date have generated the following documents:

1. Analytical results from sampling the 1-MG pond sludge;
2. Disposal records for the 1-MG pond geothermal fluids and sludge;
3. Disposal records for the liners, geofiber matting, and gravel;
4. Photographs of the site during closure activities;
5. NORM survey results of the leak collection piping;
6. Forest Service letter requesting sampling of the soil beneath the liners;
7. Sampling and Analysis Plan for characterizing the soil beneath the liners;
8. Total metals and SVOA analytical results from sampling the soil beneath the liners;
9. TCLP analytical results from sampling the soil beneath the liners;
10. Geodetic survey of the 1-MG pond and associated structures;
11. LANL response to the Forest Service's request for additional information; and
12. Forest Service letter approving the Laboratory's proposed backfill plan.



A brief discussion of each of the above documents is presented below.

1. Sludge Sampling Analytical Results

In accordance with Section 2.1.2 of the Closure Plan, a representative sample of sludge from the 1-MG service pond was collected on October 21, 2002, and submitted to General Engineering Laboratories, Charleston, SC, for the following analyses: volatile organics analysis (VOA), semi-volatile organics analysis (SVOA), total metals, and TCLP metals. Attachment 1 contains copies of the analytical reports.

2. Geothermal Fluids and Sludge Disposal Records

Key Energy Services, Inc., Farmington, NM, (OCD Permit No. NM-01-0011) transported 201,600 gallons or 4,800 barrels (60 truckloads @ 80 bbls/load) of geothermal fluids to a commercial evaporation pit at TNT Environmental, Inc., Lindrith, NM (OCD Permit No. NM-01-0008). Attachment 2 contains copies of the disposal tickets for the geothermal fluids.

In addition, Key Energy transported 43,680 gallons or 1,040 barrels of liquefied sludge to TNT's commercial land farm in Lindrith, NM. Attachment 2 contains copies of the disposal tickets for the sludge.

3. Liner Disposal Records

L&R Oilfield Services, a subcontractor to Key Energy Services, removed the primary and secondary liners and associated geofiber matting from the 1-MG service pond (see pictures of liner removal in Attachment 4). The liner was steam-cleaned prior to removal. The primary and secondary liners were recycled by L&R while the geofiber matting was disposed of at Waste Management's Rio Rancho landfill. Attachment 3 contains a copy of the disposal ticket for the geofiber matting.

Approximately 25 cubic yards of gravel from the 1-MG service pond's leak collection system was removed by L&R and disposed of at Envirotech, Inc., Farmington, NM. Attachment 3 contains a copy of the disposal ticket for the leak collection system gravel.

4. Photographs of Closure Activities

Attachment 4 contains photographs of closure activities conducted at the 1-MG service pond.

5. NORM Survey Results

In accordance with Section 7.3 of the Closure Plan, the leak collection system piping (4" perforated PVC pipe) was surveyed by Laboratory radiological technicians for Naturally Occurring Radioactive Material (NORM). Attachment 5 contains the survey results from the 100 readings taken from the 200 feet of pipe. The maximum reading of 1.54 micro R per hour is well below the 50 micro R per hour limit established by regulation (20.3.1.14 NMAC).

6. Forest Service Request for Confirmation Sampling

In a September 27, 2002, letter (Attachment 6) to Los Alamos National Laboratory, Mr. Leonard Atencio, Forest Supervisor, Santa Fe National Forest, requested that a minimum of two confirmation samples be collected from the soils beneath the 1-MG service pond's secondary liner. In addition, Mr. Atencio requested that if there is any visual evidence of leakage then the suspected material should also be sampled.

In response to the elevated concentrations of total arsenic in the crusher fines, the Laboratory initiated the following:

1. Three surface samples (RC57-03-49714, RC57-03-49718, and RC57-03-49720) were submitted to General Engineering Laboratories, Charleston, SC, for TCLP metals analysis. Attachment 9 contains a copy of General Engineering Laboratories' analytical report;
2. Two new surface samples of the crusher fines (FH#1 and FH#2) were collected from the 1-MG service pond at locations above the pond's overflow and submitted to the EES analytical laboratory for total arsenic analysis; and
3. A tuff sample from outside of the 1-MG service pond was collected and submitted to the EES analytical laboratory for total arsenic analysis.

Analytical results from the above sampling are presented in Table 1.0 below.

**Table 1.0. Underliner Soil Sampling Results for Fenton Hill 1-MG Service Pond**

Sample ID#	Sample Date	Location (Depth)	Sample Type	Total Arsenic (ppm)	TCLP Arsenic (mg/L)
<b>Samples Collected From The Bottom of the Pond</b>					
RC57-03-49714	11/18/02	surface 0"-6"	crusher fines	272	0.120
RC57-03-49715	11/18/02	depth 18"-24"	tuff	23.7	
RC57-03-49716	11/18/02	surface 0"-6"	crusher fines	197	
RC57-03-49717	11/18/02	depth 10"-16"	tuff	52.5	
RC57-03-49718	11/18/02	surface 0"-6"	crusher fines	232	0.104
RC57-03-49719	11/18/02	depth 18"-24"	tuff	8.84	
RC57-03-49720	11/18/02	surface 0"-6"	crusher fines	254	0.130
RC57-03-49721	11/18/02	depth 18"-24"	tuff	26.6	
RC57-03-49722	11/18/02	surface 0"-6"	crusher fines	204	
RC57-03-49723	11/18/02	depth 18"-24"	tuff	8.85	
<b>Samples Collected From Above the Pond's Overflow Pipe</b>					
FH#1	11/24/02	surface 0"-6"	crusher fines	232	
FH#2	11/24/02	surface 0"-6"	crusher fines	332	
<b>Samples Collected Outside of the Pond</b>					
FH#3	11/24/02	surface 0"-6"	tuff	2.57	

<sup>1</sup>Analysis by the Laboratory's EES analytical laboratory.

<sup>2</sup>Analysis by General Engineering Laboratories, Charleston, SC.

<sup>3</sup>Per 40CFR 261.24, the TCLP concentration limit for arsenic is 5.0 mg/L.

The elevated concentrations of total arsenic (232 ppm and 332 ppm) in the two surface samples collected above the 1-MG service pond's overflow suggest that the arsenic in the crusher fines is naturally occurring and not due to contamination from leaking geothermal fluids. Further, the TCLP concentration of arsenic in the crusher fines (0.120 mg/L, 0.104 mg/L, 0.130 mg/L) is well below the regulatory level (5.0 mg/L) to be a characteristic hazardous waste (40CFR 261.24).

Visual inspection of the soils beneath the liners by Laboratory personnel did not show any evidence of leakage. The crusher fines lining the pond did not display any staining, discoloration, or areas of saturation (see photographs in Attachment 4). The low moisture content of the core samples collected from the bottom of the pond support the visual record; the moisture content of the ten samples collected ranged from 5.6% to 12.48% with an average moisture content of 6.9% (see Attachment 8).

#### 7. Sampling and Analysis Plan for Underliner Soils

In response to the Forest Service's request, a Sampling and Analysis Plan (SAP) was prepared by the Laboratory to characterize the soils beneath the 1-MG service pond liners prior to backfilling. Attachment 7 contains a copy of the SAP. This SAP should be considered an addendum to the August 2002 Closure Plan.

The objectives of the SAP were to collect a sufficient number of samples to (1) perform a human health screening assessment, and (2) define the nature and extent of any potential contamination encountered. Based upon prior sampling activities conducted at the site, the minimum number of samples required to meet these objectives was determined to be five sets of inorganic and one set of organic samples. Each set consist of two samples collected from two depths.

#### 8. and 9. Underliner Soil Sampling Analytical Results

In accordance with the Sampling and Analysis Plan referenced above, on November 18, 2002, the Laboratory collected ten inorganic samples from five locations in the bottom of the 1-MG service pond using a Simco coring rig. Attachment 4 contains photographs of the sampling activities. The core barrel was drilled to a depth of approximately two feet at each location; a surface sample (0"-6") and a depth sample (18"-24") were prepared at each of the locations. Samples were submitted to the Laboratory's Earth and Environmental Sciences (EES) analytical laboratory for total metals analysis. The surface samples (0"-6") consisted of crusher fines that were imported from a crusher pit near Jemez Pueblo, NM, during the construction of the pond to "bed" the liner. The depth samples (18"-24") consisted of native tuff. In one location (RC57-03-49717), due to the hardness of the tuff the core was unable to penetrate to the target depth of 24". As a result, the depth sample at this location was collected from the 10"-16" interval.

Analytical results from the November 18<sup>th</sup> sampling are presented in Attachment 8. All results were below the Environmental Protection Agency's Preliminary Remediation Goals (PRGs) for soil with the exception of arsenic (As). Table 1.0 below presents a summary of the arsenic results.

Total arsenic concentrations in the crusher fines (surface samples) ranged from 204 ppm to 272 ppm with an average concentration of 232 ppm. In contrast, total arsenic concentrations in the tuff (depth samples) ranged from 8.8 ppm to 52.5 ppm with an average concentration of 24 ppm. On average, the data shows a ten-fold reduction (232 ppm to 24 ppm) in the concentration of total arsenic from the surface (0"-6") to depth (10"-24").

In addition to the ten inorganic samples collected, two organic samples were submitted to General Engineering Laboratories, Charleston, SC, for semi-volatile organics analysis (SVOA). Sample results are presented in Attachment 8. No target compounds were detected in either of the samples at concentrations greater than the analytical laboratory's reporting limit.

In response to the elevated concentrations of total arsenic in the crusher fines, the Laboratory initiated the following:

1. Three surface samples (RC57-03-49714, RC57-03-49718, and RC57-03-49720) were submitted to General Engineering Laboratories, Charleston, SC, for TCLP metals analysis. Attachment 9 contains a copy of General Engineering Laboratories' analytical report;
2. Two new surface samples of the crusher fines (FH#1 and FH#2) were collected from the 1-MG service pond at locations above the pond's overflow and submitted to the EES analytical laboratory for total arsenic analysis; and
3. A tuff sample from outside of the 1-MG service pond was collected and submitted to the EES analytical laboratory for total arsenic analysis.

Analytical results from the above sampling are presented in Table 1.0 below.

**Table 1.0. Underliner Soil Sampling Results for Fenton Hill 1-MG Service Pond**

Sample ID#	Sample Date	Location (Depth)	Sample Type	Total Arsenic (ppm)	TCLP Arsenic <sup>2</sup> (mg/L)
<b>Samples Collected From The Bottom of the Pond</b>					
RC57-03-49714	11/18/02	surface 0"-6"	crusher fines	272	0.120
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<b>Samples Collected Outside of the Pond</b>					
FH#3	11/24/02	surface 0"-6"	tuff	2.57	

<sup>1</sup>Analysis by the Laboratory's EES analytical laboratory.

<sup>2</sup>Analysis by General Engineering Laboratories, Charleston, SC.

<sup>3</sup>Per 40CRF 261.24, the TCLP concentration limit for arsenic is 5.0 mg/L.

The elevated concentrations of total arsenic (232 ppm and 332 ppm) in the two surface samples collected above the 1-MG service pond's overflow suggest that the arsenic in the crusher fines is naturally occurring and not due to contamination from leaking geothermal fluids. Further, the TCLP concentration of arsenic in the crusher fines (0.120 mg/L, 0.104 mg/L, 0.130 mg/L) is well below the regulatory level (5.0 mg/L) to be a characteristic hazardous waste (40CFR 261.24).

In summary, the data strongly suggest that the crusher fines imported to construct the 1-MG service pond contain elevated concentrations of naturally occurring arsenic. Further, the data suggest that the arsenic in the crusher fines is tightly bound and not highly mobile under the extraction conditions of the TCLP method (EPA Method 1311). And finally, the data confirms that the arsenic in the crusher fines is below the regulatory level to be a characteristic hazardous waste.

#### 10. Geodetic Survey of the 1-MG Service Pond

In accordance with Section 6.2 of the Closure Plan, the Laboratory conducted a geodetic survey of the 1-MG service pond and associated structures. Attachment 10 contains a copy of the survey results.

#### 11. LANL Response to the Forest Service's Request for Additional Information

On January 16, 2003, the Laboratory submitted a Progress Report and Proposed Backfill Plan (essentially a mirror of this report) to Mr. John Peterson, Jemez District Ranger. On January 27, 2003, the Forest Service verbally requested additional information on the Laboratory's Progress Report and Proposed Backfill Plan. Attachment 11 contains a copy of the Laboratory's February 3, 2003, response to the Forest Service's request.

#### 12. Forest Service Letter Approving the Laboratory's Proposed Backfill Plan

Attachment 12 contains a fax copy of a February 3, 2003, letter from Mr. John Peterson, Jemez District Ranger, approving the Laboratory's proposed plan to bury the crusher fines in the bottom of the 1-MG service pond.

### Section II-Proposed Backfill Plan

The information collected under the Closure Plan and presented above indicate the following:

- The data suggest that the crusher fines in the 1-MG service pond contain elevated concentrations of naturally occurring arsenic.
- The data confirms that the arsenic in the crusher fines is below the regulatory level to be a characteristic hazardous waste.
- The data suggest that the arsenic in the crusher fines does not pose a significant threat to ground water. This is supported by the low mobility of the arsenic, as demonstrated by the TCLP results, and the depth to ground water at the site. Depth to ground water beneath the 1-MG service pond is approximately 380 feet.

Based upon the above, the Laboratory proposes to consolidate the crusher fines into the bottom of the 1-MG service pond and backfill over them. Backfill material will come from the earthen berm that forms the southern boundary of the 1-MG service pond. This berm will provide approximately 1000 yd<sup>3</sup> of backfill material. Additional material will be imported, if necessary. A minimum of 6 feet of cover will be maintained over the buried crusher fines. As specified in Section 8.0 of the Closure Plan, all disturbed areas will be re-seeded according to Laboratory and Forest Service requirements.



Please contact me at (505) 667-7969 should you have any questions regarding this progress report and proposed plan for completing closure of the 1-MG service pond.

Sincerely,



Bob Beers  
Water Quality & Hydrology Group

BB/yg

Attachments: a/s

Cy: M. Kieling, NM OCD, Santa Fe, New Mexico, w/att.  
J. Peterson, Forest Service, Jemez Ranger District, Jemez Springs, New Mexico, w/o att.  
A. Ferrell, Forest Service, Jemez Ranger District, Jemez Springs, New Mexico, w/o att.  
C. Linn, Forest Service, Santa Fe National Forest, Santa Fe, New Mexico, w/o att.  
J. Vozella, DOE/OLASO, w/o att., MS A316  
G. Turner, DOE/OLASO, w/att., MS A316  
J. Holt, ADO, w/o att., MS A104  
C. Webster, ADSR, w/o att., MS A127  
P. Weber, EES-DO, w/o att., MS D446  
J. Hansen, EES-DO, w/ att., MS D446  
J. Thomson, EES-11, w/ att., MS D443  
S. Archuleta, P-FM, w/o att., MS D410  
B. Ramsey, RRES-DO w/o att., MS J591  
K. Hargis, RRES-DO, w/o att., MS J591  
D. Stavert, RRES-EP, w/o att., MS J591  
S. Rae, RRES-WQH, w/att., MS K497  
D. Rogers, RRES-WQH, w/o att., MS K497  
D. McInroy, RRES-R, w/o att., MS M992  
T. Rust, RRES-R, w/att., MS M992  
T. Grieggs, RRES-SWRC, w/o att., MS K490  
B. Kopp, RRES-SWRC, w/o att., MS M992  
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