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DRC-2014-006782

VIA EMAIL AND OVERNIGHT DELIVERY

November 18, 2014

Mr. Rusty Lundberg
Division of Radiation Control
Utah Department of Environmental Quality
195 North 1950 West
P.O. Box 144850
Salt Lake City, UT 84114-4820



Re: Energy Fuels Resources (USA) Inc. Response to Division of Radiation Control (“DRC”) Request for Information letter dated October 14, 2014 and e-mail Request for Revision dated October 20, 2014 for the Environmental Protection Manual (“EPM”), White Mesa Uranium Mill – RML UT1900479

Dear Mr. Lundberg:

This letter responds to the Division of Radiation Control’s (“DRC’s”) Request for Information (“RFI”) dated October 14, 2014 and the DRC’s Request for Revision dated October 20, 2014, regarding Energy Fuels Resources (USA) Inc.’s (“EFRI’s”) September 8, 2014 Environmental Protection Manual revisions submitted as required by License Condition 11.9. This letter addresses the comments from the RFI and Request for Revision. For ease of review, each of DRC’s comments is provided verbatim below in italics, followed by EFRI’s response.

The White Mesa Mill EPM is comprised of fifteen separate Standard Operating Procedures (“SOPs”) or Plans, housed in one binder. Only those SOPs which require revision are attached to this response letter in Attachment A. It is important to note that additional changes to correct typographical errors or to update procedures are also included for completeness purposes only, and were not made to respond to the RFI and Request for Revision. The redline strikeout changes from the September 8, 2014 submission have been accepted for incorporation. The changes resulting from the October 14, 2014 RFI and from the October 20, 2014 Request for Revision are shown in redline text for your convenience.

Implementation of the changes described in these SOPs will commence on the next routine sample period after the receipt of DRC approval of the EPM, that is, on the next routinely scheduled quarterly or annual sampling event unless DRC specifies otherwise.

Comments from DRC RFI dated October 14, 2014

DRC Comment:

*EFRI Standard Operating Procedure (SOP): Air Monitoring-Particulate Radionuclides
Part II Standard Operating Procedures*

1.0 Equipment

It states; "Particulates are trapped on an 8 X 10-inch glass micro fiber filter..."

RFI Question # 1:

What is the micron size of the filters used for air particulate monitoring?

EFRI Response:

EFRI is currently using the Whatman EPM 2000, with a pore size of the filters is 2.5 µm ("microns") and with a ≥99.95% efficiency for 0.3µm-size particles. The EPM 2000 has been selected by U.S. EPA as standard filter used in nationwide high-volume air sampler network. EPA requires a "Collection efficiency: 99 percent minimum as measured by the DOP test (ASTM-2986) for particles of 0.3 µm diameter.

These specifications have not been added to the SOP as it is not necessary for the completion of field activities.

The SOP has been modified to remove the EPM 1000 filter because it is no longer manufactured and has been replaced with the EPM 2000.

DRC Comment:

*EFRI Standard Operating Procedure (SOP): Air Monitoring-Particulate Radionuclides
Part II Standard Operating Procedures*

3.1 Orifice Plate

It states; "The orifice plates shall be calibrated every year as recommended by the EPA. A certified calibration laboratory that will use the EPA or an EPA-approved method ... "

RFI Question #2:

What is the EPA or approved EPA method used to calibrate the orifice plate?

EFRI Response:

The EPA methods used for orifice calibrations are as specified in 40CFR Part 50, Appendix B, Section 9.2.17. Specifically, the methods delineated in EPA-600/4-77-027a, The Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II – Ambient Air Specific Methods. Copies of the pertinent pages have been included as Attachment B to this response.

The SOP has been modified to include the appropriate reference to the EPA method.

DRC Comment:

*EFRI SOP: Surface Soil Monitoring
1.0 Soil Monitoring*

It states; "Soil samples from the northern Mill boundary and the north half of the eastern boundary (adjacent to section 22, 27 and 34) are collected approximately every 1000 feet. The remainder of the perimeter boundary soil samples are collected every 2500 feet." However, on page 2 EFRI Response: states: The additional samples will be collected at a frequency of every 500 feet along the northern mill boundary. Please correct the inconsistency.

EFRI Response:

The soil samples from the northern Mill boundary and the north half of the eastern boundary (adjacent to section 22, 27 and 34) will be collected approximately every 1000 feet. The EFRI response referenced in the comment was incorrect. Since the SOP is correct, no changes to the SOP are required.

DRC Comment:

*EFRI SOP: Surface Soil Monitoring
1.0 Soil Monitoring*

*RFI Question #3:
How will the soil sample locations be marked?*

EFRI Response:

Each soil sampling location will be marked with an aluminum tag with the sample location identification etched or painted on the tag. The tags will be attached to a metal stake driven approximately 18 inches into the ground.

The marking procedure noted above has been added to the SOP.

DRC Comment:

*EFRI SOP: Surface Soil Monitoring
1.0 Soil Monitoring*

*RFI Question #4:
Please describe how the soil sampling locations will be protected to keep the sampling area undisturbed?*

EFRI Response:

The sampling locations will be placed on the inside of the Mill's perimeter fence to reduce the chances of tampering and vandalism. The locations will be sited approximately one foot from the inside of the perimeter fence to prevent inadvertent disturbance by truck or vehicle traffic. The location markers will be designed and installed with as low a profile as possible, while still maintaining visibility for ease of location during the annual sampling program.

It is important to note that the Mill's perimeter fence was recently replaced and there are no immediate plans for construction or maintenance activities of the fence thus limiting the potential for disturbance from Mill Staff.

DRC Comment:

3.0 Analytical Requirements

RFI Question #5

Please add Th-232 and Pb-210 to the analytical requirements for soil samples based on receipt and processing of alternate feeds.

EFRI Response:

While not required by NRC Regulatory Guideline 4.14, Th-232 and Pb-210 have been added to the analytical suite for the annual soil sampling program. The SOP has been modified as requested.

DRC Comment:

Vegetation Sampling RFI Questions

RFI Question #6

Explain the rationale of only having three areas for vegetation sampling?

EFRI Response:

The current program is appropriate for assessing impacts from Mill activities because the locations currently sampled are on the property boundaries or just outside of the property boundaries which represent the areas of potential impact from Mill activities. Because the current sample locations are on or within the Mill boundaries, they will indicate whether any contamination has left the property boundary.

The three locations for vegetation sampling represent the areas most likely to be impacted by Mill activities based on prevailing wind directions. The predominant wind direction during the 2004 – 2013 period were from the north-northwest through north-northeast approximately 35% of the time. The southwest vegetation sampling location was placed to assess impacts in this area. The secondary wind

direction pattern from the south through the south-southwest occurred 18.2% of the time. The northwest and northeast vegetation sampling locations were placed to assess impacts in this direction. The three vegetation sampling areas are sited such that impacts from Mill activities would be detected in these locations and would indicate if any contamination has left the property. The vegetation sampling locations are close to the Mill process areas by design to assess Mill impacts. It is important to note that all three locations are sampled three times per year resulting in nine data points annually.

In addition, a large volume of vegetation is required to complete the analyses specified; approximately 20 kilograms of vegetation is collected for each sample at each location. The vegetation volume for each location fills a large 39-gallon trash bag. Vegetation in the area is sparse due to the desert-like ecosystem and recent drought conditions have worsened the vegetation conditions. Collecting more locations on the same schedule would have an adverse impact on the ecosystem and overall environment in the area.

DRC Comment:

Vegetation Sampling RFI Questions

RFI Question #7

Explain what type of vegetation is sampled?

EFRI Response:

As previously stated, vegetation in the area is sparse due to the desert-like ecosystem. Primarily, vegetation samples are composed of sage brush, rabbit brush, native grasses and cactus. Some variability in the sample composition is based on the time of year the sampling is conducted. The three sampling events are conducted in early spring, late spring and late fall. The time of year impacts what plants are available for collection with less grass available during the fall sampling event.

DRC Comment:

Vegetation Sampling RFI Questions

RFI Question #8

Please add U-Nat and Th-232, to the analytical requirements [for vegetation] based on receipt and processing of alternate feeds.

EFRI Response:

While not required by NRC Regulatory Guideline 4.14, Th-232 and U-Nat have been added to the analytical suite for the vegetation sampling program. The SOP has been modified as requested.

DRC Comment:

Air Monitoring - Radon Monitoring Plan

Please add at the end of section 1.1 that all detector results will be provided in the Semi-annual Environmental [Effluent] report.

EFRI Response:

The SOP has been modified as requested.

Comments from DRC Request for Revision dated October 20, 2014

DRC Comment:

A revised Table 7 Stack Sampling Requirements is provided below for your convenience. Please revise section 5.0, Stack Sampling; tab 1.4 of the Environmental Monitoring Plan to address stack sampling deficiencies.

Table 7 - Stack Sampling Requirements

Frequency	Feed Stack (Grizzly Baghouse) <u>Stack</u>	Stack for North and/or South Yellowcake Dryer <u>Stacks</u>	Yellowcake Packaging (Yellowcake Baghouse) <u>Stack</u>	<u>Vanadium Circuit Stack</u>
Quarterly	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228. None</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>
Semi-annually	<u>If operating, U-nat, Th-230, Th-232</u>	<u>If operating, U-nat, Th-230, Th-232, Ra-226, Pb-210</u>	<u>If operating, U-nat, Th-230, Th-232, Ra-226, Pb-210</u>	

Note: Grizzly baghouse stack and Vanadium Circuit stack samples shall be representative and adequate for the determination of the release rates and concentrations of radionuclides listed in Table 7 above, and do not need to be collected in an isokinetic state.

EFRI Response:

Table 5-1 [7], section 5.0, Stack Sampling; tab 1.4 of the Environmental Monitoring Plan has been modified as requested.

Letter to Rusty Lundberg

November 18, 2014

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If you have any questions, please contact me at (303) 389-4134.

Yours very truly,



ENERGY FUELS RESOURCES (USA) INC.

Kathy Weinel

Quality Assurance Manager

cc David C. Frydenlund
Dan Hillsten
Harold R. Roberts
David E. Turk
Scott Bakken

Attachments

ATTACHMENT A

REDLINE

AIR MONITORING -- RADON

1. RADON MONITORING PLAN

1.1 Locations and Frequency of Samples

Radon samples are taken at the following locations:

BHV-1

BHV-2

BHV-2A (Duplicate of BHV-2)

BHV-3 (Background location for use in assessment of background concentrations)

BHV-4

BHV-5

BHV-6

BHV-7

BHV-8

BHV-70 (Blank sample for use in assessment of effects due to sample shipment. Previously numbered as BHV-7)

See Attachment A to Section 1.1 of this Environmental Protection Manual for the locations of these monitoring stations.

Samples are collected on a quarterly basis using Radtrak® (Trac-Etch) Outdoor Air Radon Detector, (Landauer Part Number DRNM) or equivalent. One or more than ~~one~~ Radtrak® (Trac-Etch) Outdoor Air Radon Detector will be placed at each of the locations noted above (except BHV-70). The number of detectors to be placed at each location shall be as determined by the Radiation ~~A~~Safety Officer (“RSO”). If multiple Radtrak® detectors are placed at one location, the numeric average of the results for that location will be calculated and reported as the radon value for the quarter.

Radtrak® (Trac-Etch) detector results will be reported in the Semi-Annual Effluent Report.

1.2 Quality Assurance

Quality assurance of the samples is met by collecting samples in accordance with the conditions and guidelines set forth in Section 2 of this procedure. In addition, the following steps will be followed:

- a) One duplicate sample or set of duplicate samples will be collected each quarter by placing samples at the same location as the routine sample(s), at the same height as the routine sample(s), and as close to the routine sample(s) as reasonably achievable;

- b) A field blank sample will be collected each quarter to assess any concentrations resulting from shipment of the detectors;
- c) Detector locations will be monitored periodically to ensure the detectors have not been lost;
- d) Detector shipments will be inspected to ensure that all detectors are present when receiving or shipping detectors; and
- e) Monitoring data will be reviewed for consistency and data transportation issues/detections.

1.3 Analytical Requirements

Each quarterly sample will be analyzed for Radon-222. Results will be expressed in pCi/L.

2. STANDARD OPERATING PROCEDURES

2.1 Equipment

Samples will be collected using the Radtrak® (Trac-Etch) Outdoor Air Radon Detector (Landauer Part Number DRNM) or equivalent. The detectors will be returned to the supplier/manufacturer for processing and analysis. Detectors are analyzed using the “high sensitivity” methodology, which provides a lower limit of detection of 6.0 pCi/L-days.

2.2 Monitoring Methodology

The following monitoring procedures will be followed:

- a) Remove detector from package – The Radtrak® radon detectors are supplied in aluminum bags which prevent radon exposure. Open the aluminum bag and remove the clear plastic cup which has a Radtrak® detector fastened to the bottom. Detectors, before, during or after exposure should not be in locations which exceed a temperature of 160°F (70°C). There is no low temperature.
- b) Fill in the enclosed Detector Log Sheet with the serial number on the detector label. Also fill in the date installed and the location information in the location/comments area.
- c) Attach a field canister to a post or other location using the metal bracket with the open mouth of the canister facing down. The canister may be placed at any desired height (typically 3-6 feet) and preferably in a location minimizing animal damage or tampering. Remove the clear acrylic retaining ring from the canister by removing the wing nuts. Install the assembled cup inside the canister and replace the retaining ring and wing nuts in order to hold the cup in place.

- d) Leave the detectors undisturbed for the duration of the three month monitoring period.
- e) At the end of the monitoring period, remove the Radtrak® detector from the plastic cup. Peel off the gold seal provided with the shipment and cover all the holes on the top of the detector. This stops the monitoring period. Record the ending date on the Detector Log Sheet.
- f) After all of the detectors have been collected and sealed, but prior to final packaging and shipment, open a new detector and immediately cover all the holes on the top of the detector with one of the gold seals provided with the shipment. Label this detector as BHV-70 on the Detector Log Sheet. Use the same exposure time/days for BHV-70 as the eight sample detectors when listing BHV-70 on the Detector Log Sheet.
- g) Return the detectors along with a copy of the Detector Log Sheet using the laboratory provided label for shipment back to the supplying organization.

3. RECORD KEEPING

Data maintained in record form for environmental radon is:

- a) Sample period;
- b) Sample location; and
- c) Radon levels.

STACK EMISSION MONITORING PROCEDURES

WHITE MESA GAS STACK EMISSIONS

1.0 INTRODUCTION

White Mesa, or its contracted service providers, uses scientifically approved reference methods to determine gas stack emissions release concentration for radionuclide particulates. These methods conform to principles that apply to obtaining valid samples of airborne radioactive materials, using prescribed acceptable methods and materials for gas and particulate sampling. See American Standard Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities ANSI N13.1-1969. These sampling methods are also consistent with guidance contained in the U.S. Nuclear Regulatory Commission's Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills."

2.0 SAMPLING METHODOLOGIES

The sampling methods for airborne radionuclide particulates, from the yellowcake dryer and other mill effluent control stacks, are identical to methods published in the EPA's manual, Gas Stream Sampling Reference Methods for New Source Performance Standards; they are found in the EPA Manual in Appendix No. 5, "Determination of Particulate Emissions from Stationary Sources" ("EPA Method #5") and Appendix No. 17, "Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)" ("EPA Method #17). Copies of EPA Method #5 and #17 are attached to this SOP. Sampling is performed as per the methods, to ensure that the sampling and results are: (1) isokinetic; (2) representative; and (3) adequate for determination of the release rates and concentrations of U-Nat, Th-230, Ra-226 and Pb-210.

2.1 Sampling Equipment

Sampling equipment used to collect airborne radionuclide particulates from point source emission stacks at the Mill consists of equipment manufactured by Research Appliance Company (RAC), (or other equivalent apparatuses), as follows:

1. RAC Model 201009 Model 2414 stack sampler.
2. Two each, RAC Model 201044 modular sample cases. One heater box and one glassware box.
3. One each, RAC Model 201019 umbilical cord.

4. Three each, RAC Model 201013 – 100mm diameter filter holders.
5. One each, RAC Model 201005 standard pilot tube, three feet length, stainless steel/S-type probe.
6. Barometer.
7. Psychrometer.
8. Satorius Model 2432 balance or equivalent.
9. Triple beam balance.

Equipment instruction and operating manual(s) provided by the manufacturer(s) are retained at the Mill and used for specific guidance and reference.

2.2 Sample Collection

Gas stack samples are collected from emission control systems used in **Uranium** Recovery Operations at the Mill. These samples are collected from process stacks when the emission control systems are operating. They are sampled for radionuclide particulate concentrations at a frequency in accordance with Table 5-1. Sample collection methods are described in detail in EPA Method #5 and EPA Method #17, Determination of Particulate Matter Emissions From Stationary Sources. It is necessary to read and understand all procedures described in the methods and in the equipment manual. The operation of the equipment requires “hands-on” instruction from the Environment Departmental Staff from individuals who are experienced in using sample collection equipment and applying sample collection methods. The following steps are described for stack sample collection.

1. Check equipment listed in Section 2.1 of this SOP. Consult the manufacturers equipment operations manual for details.
2. Assemble equipment as described in the operations manual for sample collection EPA Method #17.
3. Follow the calibration procedure listed in the manual. If the calibration measurements are not obtained, consult the trouble shooting section of the manual for corrective instruction. Once the collection apparatus is calibrated, proceed to the next step.
4. Weigh a new glass fiber filter, record the weight, and place in the filter holder assembly.
5. Check the sample collection system for leaks.
6. Cap ends of sample probes to prevent contamination and transport sample unit to the sample location.
7. Uncap sample end and insert 3/8-diameter sample probe into the stack in the midsection of the exhaust stream.
8. Turn sample apparatus on and observe unit operation to insure a sample is being collected and the apparatus is functioning properly.

9. Collect the stack sample for at least one hour during periods of routine process operation. Note the collection time.
10. Record the information described in the manufacture's operations manual. This information is also described in the EPA Methods #5 and #17 for point source particulate emissions.
11. After sample collection is complete, turn off unit. Obtain sample filter from filter housing and place in a new plastic petri dish. Send to outside laboratory for radionuclide analysis in accordance with Table 5-1.

2.3 Sample Handling and Shipping

1. During preparation and assembly on the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.
2. Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.
3. Before moving the sampling train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened, and cap it. Remove the umbilical cord from the last impinger, and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder, and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.
4. Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.
5. Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used, and place it in a glass sample container labeled "acetone blank."
6. Carefully remove the filter from the filter holder, and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the PM cake is inside the fold. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to

the petri dish and PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

7. Send to the laboratory for radionuclide analysis.

3.0 RECORD KEEPING

Records of gas stack effluent sampling events and results of analysis are retained at the Mill. The following information is recorded:

1. Stack and Run ID
2. Date and Sampler
3. Sampled Air Volume at standard conditions
4. Sampled Water Volume at standard conditions
5. Moisture Content (volume basis)
6. Stack Gas Molecular Weight (wet basis)
7. Stack Gas Velocity
8. Stack Gas Volumetric Flow Rate (dry basis, at standard conditions)
9. Particulate Concentration
10. Percent Isokinetics
11. Emission Rates for Particulates U-Nat, Th-230, Ra-226, and Pb-210.

The data are used to calculate emission rates in pounds and pico curies per hour for radionuclide particulate concentrations.

4.0 MONITORING LOCATION AND FREQUENCY

Stack sampling must be performed during any quarter or semi-annual period that the stacks operate in accordance with the schedule in Table 5-1. During non-operational periods, stack sampling is not performed.

4.1 Yellowcake Stacks

The exhaust stack for the drying and packaging equipment associated with the yellowcake calciner is sampled on a quarterly basis during operations. The sample ports are located on the roof of the main Mill building.

4.2 Feed Stacks

The grizzly feed stack is located on the north end of the grizzly structure. This stack is accessible from a stack platform and is sampled ~~on a semi-annual~~ quarterly ~~basis~~ if this system is operating.

4.3 Vanadium Stacks

The exhaust stack for the drying and packaging equipment associated with the vanadium circuit is sampled on a quarterly basis during operations. The sample ports are located on the roof of the vanadium annex portion of the building.

5.0 ANALYSIS REQUIREMENTS

All gas stack samples are collected at the Mill according to the calendar year schedule shown below in Table 5-1. The samples will be sent to an off-site laboratory for the analysis detailed below.

**TABLE 5-1
 Sampling Frequency and Analysis**

<u>Frequency</u>	<u>Grizzly Baghouse Stack</u>	<u>North and/or South Yellowcake Dryer Stacks</u>	<u>Yellowcake Packaging Baghouse Stack</u>	<u>Vanadium Dryer Stack</u>	<u>Vanadium Packaging Stack</u>
<u>Quarterly</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>

Note: Grizzly baghouse stack and Vanadium Circuit stack samples shall be representative and adequate (based on EFRI's operational knowledge and operational conditions at the time of the sampling event) for the determination of the release rates and concentrations of radionuclides listed in Table 5-1 above, and do not need to be collected in an isokinetic state.

6.0 QUALITY ASSURANCE METHODOLOGY

6.1 Equipment Operation

Prior to performing an emission point sampling run, the sampling equipment is subjected to a dry run test to determine leakages or equipment malfunction. Calibration of equipment is checked on a periodic basis. Probe tips are protected by a protective cap while not in use to protect accuracy determinations. During transport of equipment, all openings are sealed to prevent contamination. Calculations utilized during runs to maintain isokinetic conditions are reviewed and dry run tested prior to the actual run. All containers and probes are washed prior to each usage.

Malfunction of sampling equipment, excessive malfunctions of normal operations being monitored, or percent isokinetic sampling rates greater than $\pm 10\%$ error, indicate mandatory voiding of the run or data involved.

6.2 Operations

If samples are collected from the operation of any unit which appears, in the judgment of the sampler, to be functioning in a manner not consistent with normal operations, then the sample will be voided and the system will be resampled.

6.3 Chemical Sample Control

Analyses on each period's sample shall include blanks for the filters, impinger solutions, and the rinse solutions. A field logbook shall be maintained listing data generated, determinations of volumes measured, and net gain weights of filters to provide a back up to summary data records. Filters are transmitted within plastic enclosed petri dishes. Handling of filters is only done using tweezers.

6.4 Calculations

All calculations will be retained at the Mill in both a hard copy and computer files.

The gas stack effluent concentrations (C) are calculated as follows:

$$\text{Lab Result } \mu\text{Ci (A) / Volume Sampled (V) = Effluent Concentration (C)}$$

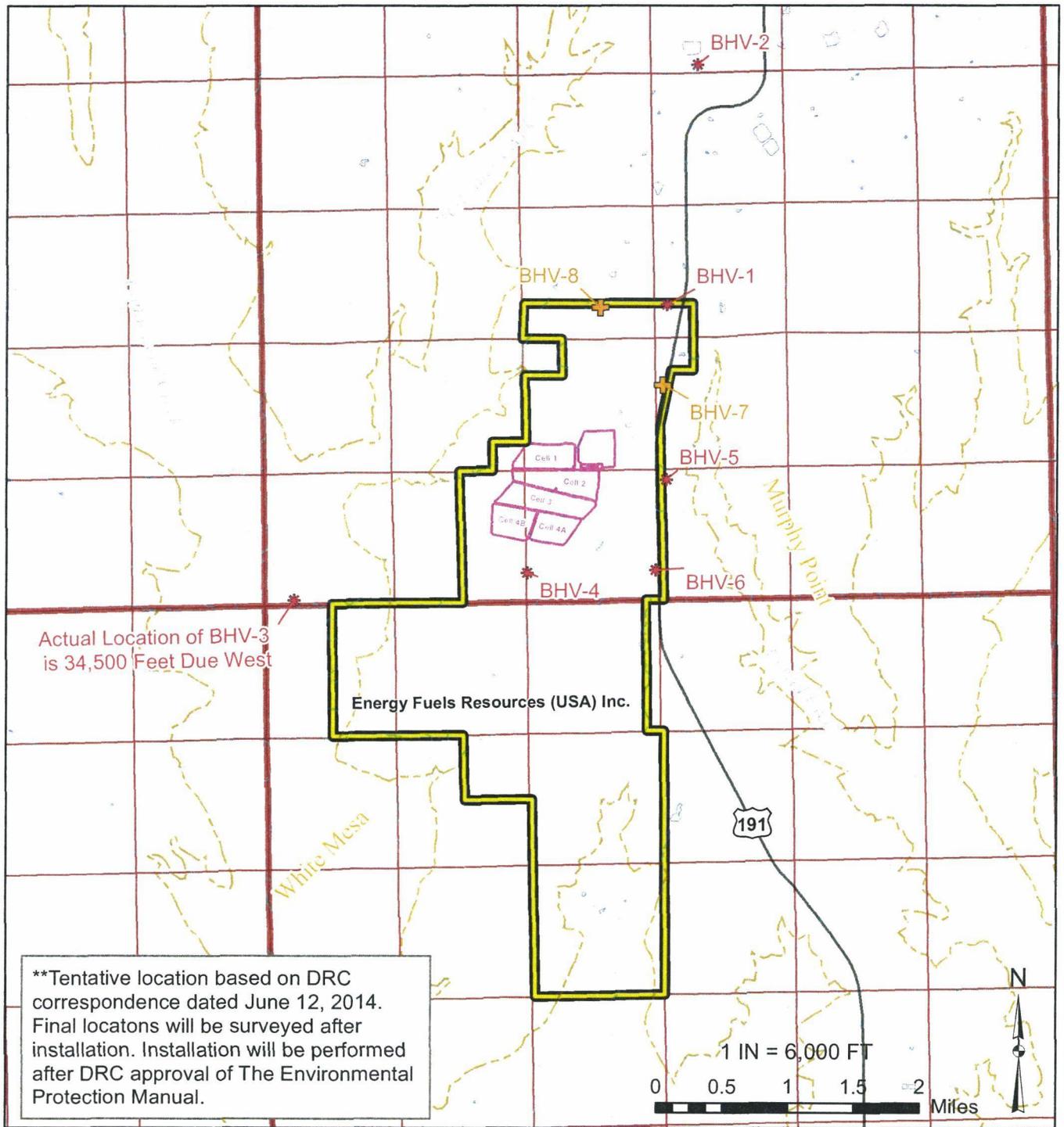
where

$$\text{Volume Sampled (V) = Flow rate (Q) * Time of sample collection in minutes (t)}$$

and

$$\text{Lab Result } \mu\text{Ci (A) = Radioisotopic activity, in } \mu\text{Ci on air filter}$$

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**Tentative location based on DRC correspondence dated June 12, 2014. Final locations will be surveyed after installation. Installation will be performed after DRC approval of The Environmental Protection Manual.

Legend

- * Existing Air Monitoring Station
- + Tentative Air Monitoring Station**
- Canyon Rim
- Drainage
- Road
- Property Boundary
- Tailings Cell
- Township and Range
- Section
- Pond

Coordinate System: NAD
1983 StatePlane Utah
South FIPS 4303 Feet



REVISIONS		Project: WHITE MESA MILL	
Date:	By:	County: San Juan	State: Utah
		Location: -	
ATTACHMENT A			
PARTICULATE MONITORING STATIONS			
		Author: mhenington	Date: 8/22/2014
		Drafted By: mhenington	

ATTACHMENT C MONTHLY CALIBRATION AND WEEKLY FLOW CHECK WORKSHEET

Site: _____
 Date of Calibration: _____
 Temperature (T_a): _____ °C / _____ K

Orifice Plate No.: _____
 Calibrator's Name: _____
 Pressure (P_a): _____ mmHg (25.4 x inches)

Monthly Calibration for the Month of:

Initial Manometer ⁽¹⁾ (ΔH) (in. H ₂ O)	Q _a ⁽²⁾ Actual Flow (m ³ /min)	Q _s ⁽³⁾ Standard Flow (m ³ /min)	Q _s ⁽⁴⁾ Standard Flow (ft ³ /min)	Adjusted Manometer ⁽⁵⁾ (in. H ₂ O)	Adjusted Q _s ^(2,3,4,5) (ft ³ /min)

Weekly Flow Check

Week	Filter Number	Start Date	Start Time	Starting Manometer (in. H ₂ O)	Stop Date	Stop Time	Stopping Manometer (in. H ₂ O)
1							
2							
3							
4							
5							

Orifice Information

Orifice S/N	
Q _a Slope (m)	
Q _a Intercept (b)	
Calibration Date	

Orifice Notes: Information to left found on the latest certification worksheet delivered with a newly certified orifice. Orifice should be calibrated annually. Slope and intercept values should come from Q_a portion of the calibration.

Monthly Calculations:

- 1) Connect the U-tube manometer to the orifice plate then read and record the initial pressure drop.
- 2) Use the manometer reading to calculate the actual flow rate using the Q_a equation below, which uses actual temperature and pressure as well as specific orifice values filled out above.
- 3) Convert actual flow rate to standard flow rate using the Q_s equation below.
- 4) Convert the standard flow rate from (m³/min) to (ft³/min).
- 5) If necessary, adjust the control screw so that the final flow rate is between 32-40 ft³/min.

$$(2) Q_a = 1/m \left\{ \left[\sqrt{\Delta H \left(\frac{T_a}{P_a} \right)} \right] - b \right\}$$

$$(3) Q_s = Q_a \left(\frac{P_a}{P_s} \right) \left(\frac{T_s}{T_a} \right)$$

$$(4) Q_s \left(\frac{ft^3}{min} \right) = 35.315 \times Q_s \left(\frac{m^3}{min} \right)$$

Where:

Q_a = Actual flow rate at field conditions (m³/min)
 Q_s = Standard flow rate at standard conditions (m³/min)
 m = Slope value from Q_a portion of orifice calibration
 b = Intercept value from Q_a portion of orifice calibration
 ΔH = Manometer reading (in. H₂O)
 T_a = Actual temperature (273 + °C = K)
 P_a = Actual atmospheric pressure (mmHg)
 T_s = Standard temperature = 298 K
 P_s = Standard atmospheric pressure = 760 mmHg



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ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Jul 10, 2014 Rootsmeter S/N 0438320 Ta (K) - 296
 Operator Tisch Orifice I.D. - 8091779 Pa (mm) - 754.38

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.3890	3.3	2.00
2	NA	NA	1.00	0.9870	6.4	4.00
3	NA	NA	1.00	0.8770	8.1	5.00
4	NA	NA	1.00	0.8370	9.0	5.50
5	NA	NA	1.00	0.6900	12.9	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9949	0.7163	1.4137	0.9956	0.7168	0.8859
0.9907	1.0038	1.9993	0.9914	1.0045	1.2528
0.9885	1.1271	2.2353	0.9892	1.1279	1.4007
0.9874	1.1797	2.3444	0.9881	1.1805	1.4690
0.9822	1.4235	2.8275	0.9829	1.4245	1.7717
Qstd slope (m) = 1.99700			Qa slope (m) = 1.25049		
intercept (b) = -0.01294			intercept (b) = -0.00811		
coefficient (r) = 0.99992			coefficient (r) = 0.99992		
y axis = SQRT[H2O(Pa/760)(298/Ta)]			y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

$$Vstd = \text{Diff. Vol} [(Pa - \text{Diff. Hg}) / 760] (298 / Ta)$$

$$Qstd = Vstd / \text{Time}$$

$$Va = \text{Diff Vol} [(Pa - \text{Diff Hg}) / Pa]$$

$$Qa = Va / \text{Time}$$

For subsequent flow rate calculations:

$$Qstd = 1/m \{ [\text{SQRT} (H2O (Pa/760) (298/Ta))] - b \}$$

$$Qa = 1/m \{ [\text{SQRT} H2O (Ta/Pa)] - b \}$$



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ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Jul 21, 2014 Rootmeter S/N 0438320 Ta (K) - 299
 Operator Tisch Orifice I.D. - 5-76-02 Pa (mm) - 754.38

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER	ORIFICE
					DIFF Hg (mm)	DIFF H2O (in.)
1	NA	NA	1.00	1.3950	3.2	2.00
2	NA	NA	1.00	0.9800	6.4	4.00
3	NA	NA	1.00	0.8780	8.1	5.00
4	NA	NA	1.00	0.8370	8.9	5.50
5	NA	NA	1.00	0.6860	12.9	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9851	0.7061	1.4066	0.9957	0.7138	0.8903
0.9808	1.0008	1.9893	0.9914	1.0116	1.2591
0.9786	1.1146	2.2241	0.9892	1.1266	1.4077
0.9776	1.1680	2.3326	0.9882	1.1806	1.4765
0.9723	1.4174	2.8132	0.9829	1.4328	1.7807
Qstd slope (m) = 1.98285			Qa slope (m) = 1.24163		
intercept (b) = 0.00883			intercept (b) = 0.00559		
coefficient (r) = 0.99986			coefficient (r) = 0.99986		
y axis = SQRT[H2O(Pa/760)(298/Ta)]			y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

$$Vstd = \text{Diff. Vol} [(Pa - \text{Diff. Hg}) / 760] (298 / Ta)$$

$$Qstd = Vstd / \text{Time}$$

$$Va = \text{Diff Vol} [(Pa - \text{Diff Hg}) / Pa]$$

$$Qa = Va / \text{Time}$$

For subsequent flow rate calculations:

$$Qstd = 1/m \{ [\text{SQRT}(\text{H2O}(\text{Pa}/760)(298/\text{Ta}))] - b \}$$

$$Qa = 1/m \{ [\text{SQRT}(\text{H2O}(\text{Ta}/\text{Pa}))] - b \}$$

BHV-1	Energy Fuels Resources - White Mesa Mill		Calibration Date: 7/10/2014			Updated: 8/22/14				
	Period: July 1, 2014 - September 30, 2014		Calibration Slope & Intercept: m= 1.25049 b= -0.0081							
					Orifice S/N: 8091779					

Week #	Filter Number	Start Date	Stop Date	Start Time	Stop Time	Total Time (min)	ΔH Starting Manometer (in. H ₂ O)	ΔH Stopping Manometer (in. H ₂ O)	ΔH Average Manometer (in. H ₂ O)	Ta Wkly. Avg. Temp. (°C)	Ta Wkly. Avg. Temp. (K)	Pa Wkly. Avg. Pressure (mmHg)	Qa Act. Flow (m ³ /min)	Qs Std. Flow (m ³ /min)	Qs Std. Flow (SCFM) (ft ³ /min)	Total Std. Volume (m ³)	Tare Weight (g)	Gross Weight (g)	Net Weight (mg)	Loading (mg/m ³)	Percent Onstream (%)	
1	7130505	7/7/2014	7/14/2014	7278.3	17366.2	10087.9	4.0	4.0	4.0	19.0	292.2	621.03	1.10	0.92	32.48	9278.3	4.4442	4.4905	46.3	0.0050	100.1	
2	7123199			17366.2	27408.8	10042.6	3.5	3.6	3.6	20.0	293.2	621.03	1.04	0.87	30.56	8689.7	4.5221	4.5319	9.8	0.0011	99.6	
3	7129193			27408.8	37640.7	10231.9	4.0	3.5	3.8	20.0	293.2	621.03	1.07	0.89	31.40	9098.0	4.5172	4.5218	4.6	0.0005	101.5	
4	7129187			37640.7	47869.5	10228.8	3.0	3.9	3.5	20.0	293.2	621.03	1.03	0.85	30.13	8726.1	4.5303	4.5360	5.7	0.0007	101.5	
5				47869.5	57734	9864.5	3.5	4.0	3.8	20.0	293.2	621.03	1.07	0.89	31.40	8771.3	4.5295	4.5380	8.5	0.0010	97.9	
6				57734	67754.2	10020.2	4.0	3.8	3.9	20.0	293.2	621.03	1.09	0.91	32.02	9085.1	4.5402	4.5464	6.2	0.0007	99.4	
7				67754.2	77803.4	10049.2	3.6	3.9	3.8	20.0	293.2	621.03	1.07	0.89	31.40	8935.5	4.5359	4.5435	7.6	0.0009	99.7	
8				77803.4	83387.6	5584.2	3.7	3.6	3.7	20.0	293.2	621.03	1.06	0.88	30.98	4899.1	4.5536	4.5610	7.4	0.0015	55.4	
9				83387.6	93412.4	10024.8	3.8	4.0	3.9	20.0	293.2	621.03	1.09	0.91	32.02	9089.3	4.5542	4.5605	6.3	0.0007	99.5	
10				93412.4	103434.8	10022.4	4.0	4.0	4.0	20.0	293.2	621.03	1.11	0.92	32.42	9202.2	4.5613	4.6928	131.5	0.0143	99.4	
11				103434.8	113555.1	10120.3	3.5	3.6	3.6	20.0	293.2	621.03	1.04	0.87	30.56	8757.0	4.5489	4.5543	5.4	0.0006	100.4	
12				17921.6	27945.8	10024.2	3.6	3.8	3.7	20.0	293.2	621.03	1.06	0.88	31.19	8854.0	4.5355	4.5454	9.9	0.0011	99.4	
13				27945.6	38066.3	10120.7	3.7	4.0	3.9	20.0	293.2	621.03	1.08	0.90	31.81	9117.6	4.5355	4.5454	9.9	0.0011	100.4	
						Totals	126421.7						13.92	11.56	408.38	112503.2	58.908	59.168	259.1	0.0291		
						Averages	9724.7	3.7	3.8	3.8	19.9	293.1	621.03	1.07	0.89	31.41	8654.1	4.531	4.551	19.9	0.0022	96.5

Comments:
 Insert weekly flow check values in yellow columns.
 Blue column values are calculated.
 Green columns are calculated averages from the met station.
 Insert filter weight values into orange columns.

ATTACHMENT E

AIR MONITORING -- RADON

1. RADON MONITORING PLAN

1.1 Locations and Frequency of Samples

Radon samples are taken at the following locations:

BHV-1

BHV-2

BHV-2A (Duplicate of BHV-2)

BHV-3 (Background location for use in assessment of background concentrations)

BHV-4

BHV-5

BHV-6

BHV-7

BHV-8

BHV-70 (Blank sample for use in assessment of effects due to sample shipment. Previously numbered as BHV-7)

See Attachment A to Section 1.1 of this Environmental Protection Manual for the locations of these monitoring stations.

Samples are collected on a quarterly basis using Radtrak® (Trac-Etch) Outdoor Air Radon Detector, (Landauer Part Number DRNM) or equivalent. One or more than ~~one~~ Radtrak® (Trac-Etch) Outdoor Air Radon Detector will be placed at each of the locations noted above (except BHV-70). The number of detectors to be placed at each location shall be as determined by the Radiation ~~A~~Safety Officer (“RSO”). If multiple Radtrak® detectors are placed at one location, the numeric average of the results for that location will be calculated and reported as the radon value for the quarter.

Radtrak® (Trac-Etch) detector results will be reported in the Semi-Annual Effluent Report.

1.2 Quality Assurance

Quality assurance of the samples is met by collecting samples in accordance with the conditions and guidelines set forth in Section 2 of this procedure. In addition, the following steps will be followed:

- a) One duplicate sample or set of duplicate samples will be collected each quarter by placing samples at the same location as the routine sample(s), at the same height as the routine sample(s), and as close to the routine sample(s) as reasonably achievable;

- b) A field blank sample will be collected each quarter to assess any concentrations resulting from shipment of the detectors;
- c) Detector locations will be monitored periodically to ensure the detectors have not been lost;
- d) Detector shipments will be inspected to ensure that all detectors are present when receiving or shipping detectors; and
- e) Monitoring data will be reviewed for consistency and data transportation issues/detections.

1.3 Analytical Requirements

Each quarterly sample will be analyzed for Radon-222. Results will be expressed in pCi/L.

2. STANDARD OPERATING PROCEDURES

2.1 Equipment

Samples will be collected using the Radtrak® (Trac-Etch) Outdoor Air Radon Detector (Landauer Part Number DRNM) or equivalent. The detectors will be returned to the supplier/manufacturer for processing and analysis. Detectors are analyzed using the “high sensitivity” methodology, which provides a lower limit of detection of 6.0 pCi/L-days.

2.2 Monitoring Methodology

The following monitoring procedures will be followed:

- a) Remove detector from package – The Radtrak® radon detectors are supplied in aluminum bags which prevent radon exposure. Open the aluminum bag and remove the clear plastic cup which has a Radtrak® detector fastened to the bottom. Detectors, before, during or after exposure should not be in locations which exceed a temperature of 160°F (70°C). There is no low temperature.
- b) Fill in the enclosed Detector Log Sheet with the serial number on the detector label. Also fill in the date installed and the location information in the location/comments area.
- c) Attach a field canister to a post or other location using the metal bracket with the open mouth of the canister facing down. The canister may be placed at any desired height (typically 3-6 feet) and preferably in a location minimizing animal damage or tampering. Remove the clear acrylic retaining ring from the canister by removing the wing nuts. Install the assembled cup inside the canister and replace the retaining ring and wing nuts in order to hold the cup in place.

- d) Leave the detectors undisturbed for the duration of the three month monitoring period.
- e) At the end of the monitoring period, remove the Radtrak® detector from the plastic cup. Peel off the gold seal provided with the shipment and cover all the holes on the top of the detector. This stops the monitoring period. Record the ending date on the Detector Log Sheet.
- f) After all of the detectors have been collected and sealed, but prior to final packaging and shipment, open a new detector and immediately cover all the holes on the top of the detector with one of the gold seals provided with the shipment. Label this detector as BHV-70 on the Detector Log Sheet. Use the same exposure time/days for BHV-70 as the eight sample detectors when listing BHV-70 on the Detector Log Sheet.
- g) Return the detectors along with a copy of the Detector Log Sheet using the laboratory provided label for shipment back to the supplying organization.

3. RECORD KEEPING

Data maintained in record form for environmental radon is:

- a) Sample period;
- b) Sample location; and
- c) Radon levels.

STACK EMISSION MONITORING PROCEDURES

WHITE MESA GAS STACK EMISSIONS

1.0 INTRODUCTION

White Mesa, or its contracted service providers, uses scientifically approved reference methods to determine gas stack emissions release concentration for radionuclide particulates. These methods conform to principles that apply to obtaining valid samples of airborne radioactive materials, using prescribed acceptable methods and materials for gas and particulate sampling. See American Standard Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities ANSI N13.1-1969. These sampling methods are also consistent with guidance contained in the U.S. Nuclear Regulatory Commission's Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills."

2.0 SAMPLING METHODOLOGIES

The sampling methods for airborne radionuclide particulates, from the yellowcake dryer and other mill effluent control stacks, are identical to methods published in the EPA's manual, Gas Stream Sampling Reference Methods for New Source Performance Standards; they are found in the EPA Manual in Appendix No. 5, "Determination of Particulate Emissions from Stationary Sources" ("EPA Method #5") and Appendix No. 17, "Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)" ("EPA Method #17). Copies of EPA Method #5 and #17 are attached to this SOP. Sampling is performed as per the methods, to ensure that the sampling and results are: (1) isokinetic; (2) representative; and (3) adequate for determination of the release rates and concentrations of U-Nat, Th-230, Ra-226 and Pb-210.

2.1 Sampling Equipment

Sampling equipment used to collect airborne radionuclide particulates from point source emission stacks at the Mill consists of equipment manufactured by Research Appliance Company (RAC), (or other equivalent apparatuses), as follows:

1. RAC Model 201009 Model 2414 stack sampler.
2. Two each, RAC Model 201044 modular sample cases. One heater box and one glassware box.
3. One each, RAC Model 201019 umbilical cord.

4. Three each, RAC Model 201013 – 100mm diameter filter holders.
5. One each, RAC Model 201005 standard pilot tube, three feet length, stainless steel/S-type probe.
6. Barometer.
7. Psychrometer.
8. Satorius Model 2432 balance or equivalent.
9. Triple beam balance.

Equipment instruction and operating manual(s) provided by the manufacturer(s) are retained at the Mill and used for specific guidance and reference.

2.2 Sample Collection

Gas stack samples are collected from emission control systems used in Uranium Recovery Operations at the Mill. These samples are collected from process stacks when the emission control systems are operating. They are sampled for radionuclide particulate concentrations at a frequency in accordance with Table 5-1. Sample collection methods are described in detail in EPA Method #5 and EPA Method #17, Determination of Particulate Matter Emissions From Stationary Sources. It is necessary to read and understand all procedures described in the methods and in the equipment manual. The operation of the equipment requires “hands-on” instruction from the Environment Departmental Staff from individuals who are experienced in using sample collection equipment and applying sample collection methods. The following steps are described for stack sample collection.

1. Check equipment listed in Section 2.1 of this SOP. Consult the manufacturers equipment operations manual for details.
2. Assemble equipment as described in the operations manual for sample collection EPA Method #17.
3. Follow the calibration procedure listed in the manual. If the calibration measurements are not obtained, consult the trouble shooting section of the manual for corrective instruction. Once the collection apparatus is calibrated, proceed to the next step.
4. Weigh a new glass fiber filter, record the weight, and place in the filter holder assembly.
5. Check the sample collection system for leaks.
6. Cap ends of sample probes to prevent contamination and transport sample unit to the sample location.
7. Uncap sample end and insert 3/8-diameter sample probe into the stack in the midsection of the exhaust stream.
8. Turn sample apparatus on and observe unit operation to insure a sample is being collected and the apparatus is functioning properly.

9. Collect the stack sample for at least one hour during periods of routine process operation. Note the collection time.
10. Record the information described in the manufacture's operations manual. This information is also described in the EPA Methods #5 and #17 for point source particulate emissions.
11. After sample collection is complete, turn off unit. Obtain sample filter from filter housing and place in a new plastic petri dish. Send to outside laboratory for radionuclide analysis in accordance with Table 5-1.

2.3 Sample Handling and Shipping

1. During preparation and assembly on the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.
2. Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.
3. Before moving the sampling train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened, and cap it. Remove the umbilical cord from the last impinger, and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder, and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.
4. Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.
5. Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used, and place it in a glass sample container labeled "acetone blank."
6. Carefully remove the filter from the filter holder, and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the PM cake is inside the fold. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to

the petri dish and PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

7. Send to the laboratory for radionuclide analysis.

3.0 RECORD KEEPING

Records of gas stack effluent sampling events and results of analysis are retained at the Mill. The following information is recorded:

1. Stack and Run ID
2. Date and Sampler
3. Sampled Air Volume at standard conditions
4. Sampled Water Volume at standard conditions
5. Moisture Content (volume basis)
6. Stack Gas Molecular Weight (wet basis)
7. Stack Gas Velocity
8. Stack Gas Volumetric Flow Rate (dry basis, at standard conditions)
9. Particulate Concentration
10. Percent Isokinetics
11. Emission Rates for Particulates U-Nat, Th-230, Ra-226, and Pb-210.

The data are used to calculate emission rates in pounds and pico curies per hour for radionuclide particulate concentrations.

4.0 MONITORING LOCATION AND FREQUENCY

Stack sampling must be performed during any quarter or semi-annual period that the stacks operate in accordance with the schedule in Table 5-1. During non-operational periods, stack sampling is not performed.

4.1 Yellowcake Stacks

The exhaust stack for the drying and packaging equipment associated with the yellowcake calciner is sampled on a quarterly basis during operations. The sample ports are located on the roof of the main Mill building.

4.2 Feed Stacks

The grizzly feed stack is located on the north end of the grizzly structure. This stack is accessible from a stack platform and is sampled ~~on a semi-annual~~quarterly ~~basis~~ if this system is operating.

4.3 Vanadium Stacks

The exhaust stack for the drying and packaging equipment associated with the vanadium circuit is sampled on a quarterly basis during operations. The sample ports are located on the roof of the vanadium annex portion of the building.

5.0 ANALYSIS REQUIREMENTS

All gas stack samples are collected at the Mill according to the calendar year schedule shown below in Table 5-1. The samples will be sent to an off-site laboratory for the analysis detailed below.

**TABLE 5-1
 Sampling Frequency and Analysis**

<u>Frequency</u>	<u>Grizzly Baghouse Stack</u>	<u>North and/or South Yellowcake Dryer Stacks</u>	<u>Yellowcake Packaging Baghouse Stack</u>	<u>Vanadium Dryer Stack</u>	<u>Vanadium Packaging Stack</u>
<u>Quarterly</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>	<u>If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.</u>

Note: Grizzly baghouse stack and Vanadium Circuit stack samples shall be representative and adequate (based on EFRI's operational knowledge and operational conditions at the time of the sampling event) for the determination of the release rates and concentrations of radionuclides listed in Table 5-1 above, and do not need to be collected in an isokinetic state.

6.0 QUALITY ASSURANCE METHODOLOGY

6.1 Equipment Operation

Prior to performing an emission point sampling run, the sampling equipment is subjected to a dry run test to determine leakages or equipment malfunction. Calibration of equipment is checked on a periodic basis. Probe tips are protected by a protective cap while not in use to protect accuracy determinations. During transport of equipment, all openings are sealed to prevent contamination. Calculations utilized during runs to maintain isokinetic conditions are reviewed and dry run tested prior to the actual run. All containers and probes are washed prior to each usage.

Malfunction of sampling equipment, excessive malfunctions of normal operations being monitored, or percent isokinetic sampling rates greater than $\pm 10\%$ error, indicate mandatory voiding of the run or data involved.

6.2 Operations

If samples are collected from the operation of any unit which appears, in the judgment of the sampler, to be functioning in a manner not consistent with normal operations, then the sample will be voided and the system will be resampled.

6.3 Chemical Sample Control

Analyses on each period's sample shall include blanks for the filters, impinger solutions, and the rinse solutions. A field logbook shall be maintained listing data generated, determinations of volumes measured, and net gain weights of filters to provide a back up to summary data records. Filters are transmitted within plastic enclosed petri dishes. Handling of filters is only done using tweezers.

6.4 Calculations

All calculations will be retained at the Mill in both a hard copy and computer files.

The gas stack effluent concentrations (C) are calculated as follows:

$$\text{Lab Result } \mu\text{Ci (A)} / \text{Volume Sampled (V)} = \text{Effluent Concentration (C)}$$

where

Volume Sampled (V) = Flow rate (Q) * Time of sample collection in minutes (t)

and

Lab Result $\mu\text{Ci (A)}$ = Radioisotopic activity, in μCi on air filter

SURFACE SOIL MONITORING

PART I SOIL MONITORING PLAN

1.0 SOIL MONITORING

Surface soils are sampled at the eight air monitoring sites and at spaced intervals around the perimeter boundary of the Mill property. The sampling locations are shown in Figure 1. Soil samples from the northern Mill boundary and the north half of the eastern boundary (adjacent to Sections 22, 27 and 34) are collected approximately every 1000 feet. The remainder of the perimeter boundary soil samples are collected every 2500 feet. Soil samples are taken once per year during August or as soon as possible thereafter, but no later than September 30 of the year. Each soil sampling location will be marked with an aluminum tag with the sample location identification etched or painted on the tag. The tags will be attached to a metal stake driven approximately 18 inches into the ground. The sampling locations will be placed on the inside of the Mill's perimeter fence to prevent tampering and vandalism. The locations will be sited approximately one foot from the inside of the perimeter fence to prevent inadvertent disturbance by truck or vehicle traffic. The location markers will be designed and installed with as low a profile as possible, while still maintaining visibility for ease of location during the annual sampling program.

In addition, a soil sample could be taken from Westwater Creek, in the place of a water sample. However, a sediment (soil) sample would only be taken at Westwater Creek if water was not available. In the event that a soil sample is collected in place of a water sample for Westwater Creek, the sample should be analyzed for the same parameters as those called for in this SOP (Radium-226 and U-nat). Refer to SOP No. PBL-EP-3 for details regarding collection of a water sample from Westwater Creek.

2.0 SAMPLING AND ANALYTICAL QUALITY ASSURANCE

The sample bags are marked for location identification and are submitted to the analytical laboratory accompanied by Chain-of-Custody forms. (Attachment A)

Analytical quality assurance for soil monitoring is based on the contract laboratory's quality controls such as blanks, duplicates, and standard percentage recovery. The laboratory is committed to meet the LLD values for radionuclides contained in U.S. NRC Regulatory Guides 4.14 and 4.15 and will perform re-runs on all samples not meeting these limits. Appropriate laboratory control and quality assurance data will be provided by the contract laboratory, or equivalent, including LLD information.

3.0 ANALYTICAL REQUIREMENTS

All soil samples will be analyzed, on a dry basis for the following radionuclides: Ra-226 Th-232, Pb-210, and U-Nat. Analytical results will be reported in appropriate radiological units such as pico curies per gram or micro curies per kilogram.

PART II SOIL MONITORING STANDARD OPERATING PROCEDURES

1.0 SURFACE SOIL SAMPLING

1.1 Equipment

Equipment used for soil sampling is as follows:

1. Tape measure or measuring stick calibrated to 1 foot and to one centimeter.
2. Clean trowel or shovel.
3. Clean sample containers.

1.2 Soil Sampling Procedure

Soil samples are collected using a clean trowel or shovel to excavate a soil sample evenly across a one square foot area at a depth of one centimeter. The one centimeter excavation depth is maintained by using the tape measure or other suitable calibrated measuring stick. As the soil is being collected, it is placed directly into the sample container. The sample container is then identified with a label (see Section 2.1 below).

2.0 SAMPLING QUALITY ASSURANCE

2.1 Sample Duplicates

Soil sample duplicates will be collected at a frequency of 1 duplicate per 20 samples. The duplicates will be submitted blind to the laboratory and will be named as follows:

N1D where:

- N = Northern boundary
- 1 = Sequential number of the northern boundary sample
- D = Duplicate of sample N1

Duplicate precision will be discussed in the Semi-Annual Effluent Report. Duplicate precision will be assessed as follows:

- a) Relative Percent Difference.

RPDs will be calculated in comparisons of duplicate and original field sample results. Section 3.3 will apply when the $RPD \geq 35\%$, unless the measured concentrations are less than 5 times the required detection limit (Standard Methods, 1998) (EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February 1994, 9240.1-05-01, p. 25).

2.2 Sample Labeling

Each sample must be labeled and all sample labels must be filled out in ink and numbered. The following information must be contained on the label:

1. Project and facility.
2. Company name
3. Date and time of sample collection.
4. Sampler's initials.
5. Sample location.
6. Requested Analytical Parameters

2.2 Sample Chain-of-Custody

During sampling activities, traceability of the sample must be maintained upon sample collection until the laboratory data is issued. Information on the custody, handling, transfer, and shipment of the samples will be recorded on a Chain-of-Custody form (COC). The sampler is responsible for filling out the COC form. The COC form will be signed by the sampler when the sampler relinquishes the samples to anyone else. A COC form is to be completed for each set of samples placed in a sample shipping container and is to include the following:

1. Sampler's name.
2. Date and time of collection.
3. Sample location.
4. Sample type.
5. Analysis requested.
6. Signatures of persons releasing custody.
7. Signatures of persons accepting custody, dates, and times.

Copies of the COC forms and all custody documentation when received will be retained in appropriate files at the Mill. The original COC form remains with the samples until disposal of the samples.

2.3 Sample Handling and Shipping

Samples will be placed in shipping containers and transported to the contract laboratory. COC forms will be placed inside a resealable bag and placed inside the sample shipping container.

2.4 Record Keeping

All soil sample data are retained in the files and when analytical results are available the results are entered into a computer file and retained in the files. Laboratory analytical data are stored in the soil files after the data has been entered on a computer file.

3.0 ANALYTICAL QUALITY ASSURANCE

3.1 Data Validation and Quality Control

Laboratory analyses will be reviewed by the technical staff and any identifiable anomalies in results noted and investigated. Appropriate measures to confirm or disaffirm results will be pursued, such as laboratory conversation, analytical sample rerun, or trend analysis.

3.2 Quality Assurance and Data Validation

The contract laboratory will prepare and retain a copy of all analytical and quality control documentation. The laboratory will provide hard copy information in each data package submitted in accordance with quality assurance objectives for the surface soil quality assurance project plan that is: COC forms, cover sheets with comments, narratives, samples analyzed, reporting limits and LLD values for analytes, and analytical results of quality control samples. The data reduction and laboratory review will be documented, signed, and dated by the analyst.

3.3 Corrective Action

Corrective action will be taken for any deficiencies or deviations noted in the procedures or anomalous results, such as but not limited to additional sample collection, sample re-run, laboratory inquires, or other actions as appropriate.

Corrective actions for duplicate deviations shall first determine if the deviation is indicative of a systematic issue. If the deviation is limited in scope and nature, the QA Manager will:

1. Notify the laboratory,
 - a. Request the laboratory review all analytical results for transcription and calculation errors, and
 - b. If the samples are still within holding time, the QA Manager may request the laboratory re-analyze the affected samples.



Chain of Custody and Analytical Request Record

PLEASE PRINT, provide as much information as possible. Refer to corresponding notes on reverse side.

Company Name:			Project Name, PWS #, Permit #, Etc.:																
Report Mail Address:			Contact Name, Phone, Fax, E-mail:					Sampler Name if other than Contact:											
Invoice Address:			Invoice Contact & Phone #:					Purchase Order #:		ELI Quote #:									
Report Required For: POTW/WWTP <input type="checkbox"/> DW <input type="checkbox"/> Other _____ Special Report Formats - ELI must be notified prior to sample submittal for the following: NELAC <input type="checkbox"/> A2LA <input type="checkbox"/> Level IV <input type="checkbox"/> Other _____ EDD/EDT <input type="checkbox"/> Format _____			Number of Containers Sample Type: A W S V B O Air Water Soils/Solids Vegetation Bioassay Other	ANALYSIS REQUESTED					SEE ATTACHED Normal Turnaround (TAT) RUSH Turnaround (TAT)	Notify ELI prior to RUSH sample submittal for additional charges and scheduling Comments:			Shipped by: _____ Cooler ID(s) _____ Receipt Temp _____ ° C Custody Seal Intact Y N Signature Match Y N Lab ID _____						
SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)		Collection Date		Collection Time	MATRIX														
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
Custody Record MUST be Signed		Relinquished by (print) _____			Date/Time _____			Signature _____			Received by (print) _____			Date/Time _____			Signature _____		
		Relinquished by (print) _____			Date/Time _____			Signature _____			Received by (print) _____			Date/Time _____			Signature _____		
		Sample Disposal: Return to client: _____			Lab Disposal: _____			Sample Type: _____			LABORATORY USE ONLY # of fractions _____								

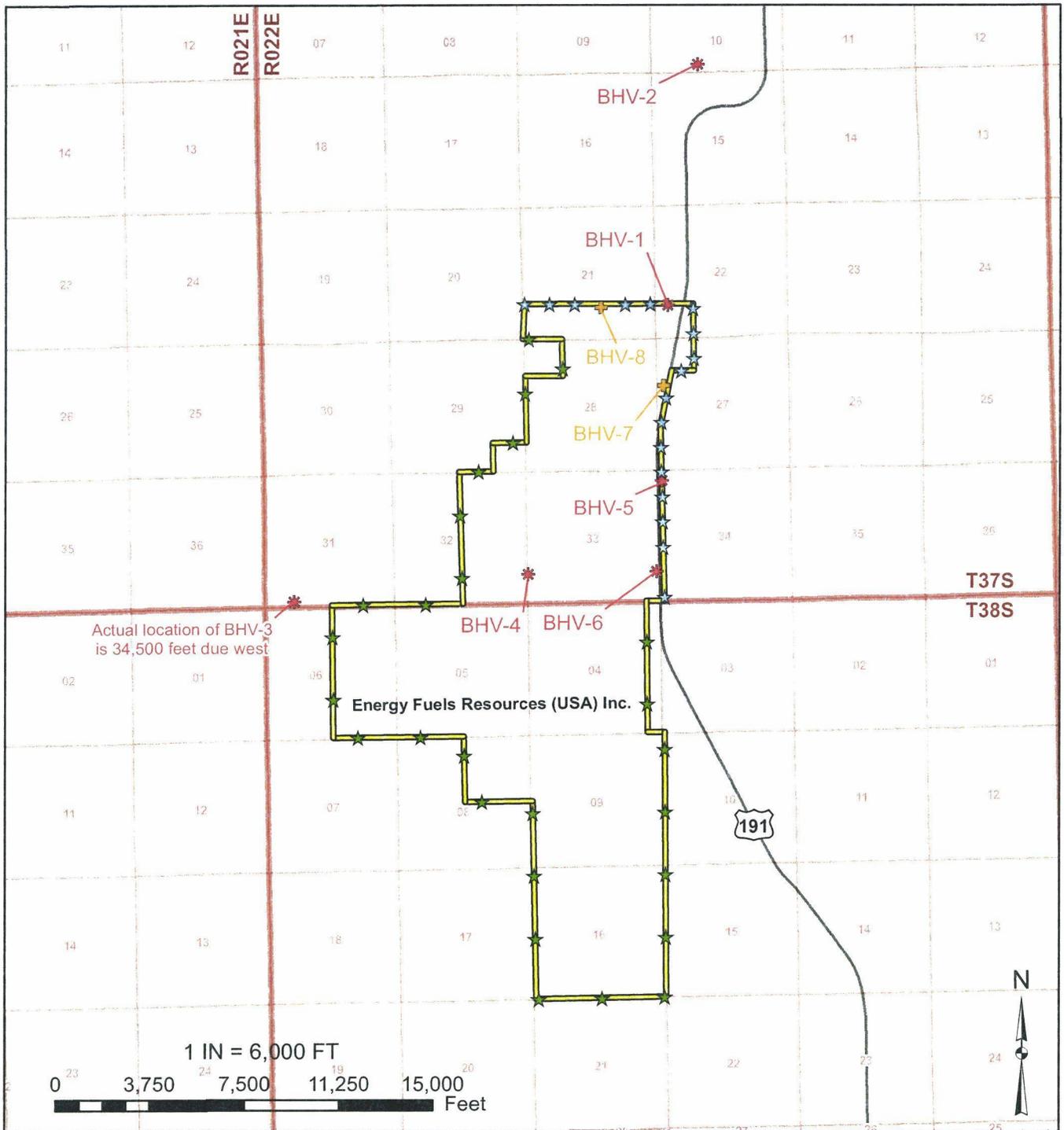
ATTACHMENT A

LABORATORY USE ONLY

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All subcontracted data will be clearly notated on your analytical report.

Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, & links.

W:\USA\Utah\MILL\MapInfo\SoilMonitoringLocations.mxd / 9/2/2014 9:16:06 AM by mhenington



Legend

Program

- ★ 1,000 Feet
- ★ 2,500 Feet
- ✱ Existing Air Monitoring Station
- ✚ Tentative Air Monitoring Station
- Property Boundary
- Road
- ▭ Township and Range
- ▭ Section

Coordinate System: NAD
1983 StatePlane Utah
South FIPS 4303 Feet



REVISIONS		Project: WHITE MESA MILL	
Date:	By:	County: San Juan	State: Utah
		Location: -	
<p>FIGURE 1</p> <p>SOIL MONITORING LOCATIONS</p>			
Author: mhenington		Date: 9/5/2014	Drafted By: mhenington

VEGETATION MONITORING

PART I VEGETATION MONITORING PLAN

1.0 VEGETATION MONITORING PLAN

Vegetation is sampled in early spring, late spring, and late fall at three locations around the Mill. These locations are: Northeast Area (near BHV-1), Northwest Area (½ mile west of BHV-1) and the Southwest Area (West of BHV-4 and south off Cell 3).

2.0 QUALITY ASSURANCE

Quality assurance for vegetation monitoring is based on the contract laboratory's quality controls such as duplicates, blanks, standard percent recovery, and spike percent recovery. The laboratory will also follow U.S. EPA Guide SW-846 and U.S. NRC Regulatory Guides 4.14 and 4.15 when analyzing the vegetation samples. The laboratory is committed to meet the LLD values for radionuclides addressed in these guidelines and will perform re-runs on all samples not meeting these limits.

3.0 ANALYTICAL REQUIREMENTS

Each vegetation sample will be analyzed for Ra-226, U-Nat, Th-232, and Pb-210 radionuclide concentrations. Results will be expressed in units of picocuries per gram (pCi/g) or micro curies per kilogram (μ ci/kg), on a wet basis.

PART II VEGETATION MONITORING STANDARD OPERATING PROCEDURES

1.0 VEGETATION SAMPLING

1.1 Equipment

Equipment used for vegetation sampling is as follows:

1. Scissors
2. Large plastic sample bags

1.2 Vegetation Sampling Procedure

Vegetation samples are collected and removed at the surface with scissors at each sampling location. The vegetation sample is enclosed in a large plastic bag. Each sample will be weighed upon return to the office and must weigh at least three kilograms in order for the

laboratory to meet the required LLD values outlined in U.S. NRC Regulatory Guide 4.14. In addition, as vegetation samples are collected efforts will be made to minimize the amount of soil in the samples. The sample bag is then labeled (see Section 2.1).

2.0 SAMPLING QUALITY ASSURANCE

2.1 Sample Labeling

All sample labels must be filled out in waterproof ink and numbered. The date, time, sampler's initials, and the sample location will be completed at the time the sample is collected. The following information will be included on the label:

1. Project and facility.
2. Sampler's company affiliation.
3. Date and time of sample collection.
4. Sampler's initials.
5. Sample location.
6. Weight of sample.
7. Requested analytical parameters.

2.2 Sample Chain-of-Custody

During sampling activities, traceability of the sample must be maintained upon sample collection until the laboratory data is issued. Information on the custody, handling, transfer, and shipment of the samples will be recorded on a Chain-of-Custody form (COC). The sampler is responsible for filling out the COC form. The COC form will be signed by the sampler when the sampler relinquishes the samples to anyone else. A COC form is to be completed for each set of samples placed in a shipping container and is to include the following:

1. Sampler's name.
2. Date and time of collection.
3. Sample location.
4. Sample type.
5. Analysis requested.

6. Signatures of persons releasing custody.
7. Signatures of persons accepting custody, dates, and times.

Copies of the COC forms and all custody documentation when received will be retained in appropriate files at the Mill. The original COC form remains with the samples until analysis of the samples. After sample analysis, the COC form will be sent to the Environmental Department along with the analyses.

2.3 Sample Handling and Shipping

Sample bags will be packaged in large shipping boxes and transported to the contract laboratory. COC forms will be placed inside a sealed bag and placed inside the shipping box.

2.4 Record Keeping

All vegetation sampling data will be retained in a file. When analytical data becomes available, the data is entered into a computer file and retained in the files. All laboratory analytical data is stored in the vegetation files after the data has been entered into the computer file.

3.0 ANALYTICAL QUALITY ASSURANCE

3.1 Data Validation and QC Review

Laboratory analyses will be reviewed by the technical staff and any identifiable anomalies in results noted and investigated. Appropriate measures to confirm or disaffirm results will be pursued, such as laboratory conversation, analytical sample rerun, or trend analysis.

3.2 Quality Assurance and Data Validation

The contract laboratory will prepare a copy of and retain all analytical and QC documentation. The laboratory will provide the Mill with paper copies of the following in each data package, in accordance with QA objectives for the Surface Soil QA Project Plan:

1. COC forms
2. Cover sheets with comments
3. Narrative
4. Samples analyzed
5. Reporting limits and LLD values for analytes
6. Analytical results of QC samples

The data reduction and laboratory review will be documented, signed, and dated by the

contract laboratory analyst.

3.3 Corrective Action

Corrective action will be taken for any deficiencies or deviations noted in the procedures or anomalous results, such as but not limited to additional sample collection, sample re-run, laboratory inquires, or other actions as appropriate.

CLEAN

AIR MONITORING – PARTICULATE RADIONUCLIDES

PART I AIR MONITORING PLAN

1.0 PARTICULATE RADIONUCLIDE AIR MONITORING

Air samples for monitoring particulate radionuclides are taken at the following locations:
(See Attachment A)

BHV-1	Northeast of the Mill at the meteorological station.
BHV-2	Approximately 2.5 miles north of the Mill.
BHV-4	Approximately 400 yards south of Cell No. 4.
BHV-5	Approximately 100 yards south of the intersection of Highway 191 and the Mill access road.
BHV-6	Approximately 0.5 miles south of BHV-5 along Highway 191.
BHV-7	Approximately 0.8 miles south of BHV-1 along Highway 191.
BHV-8	Approximately 0.6 miles west of BHV-1.

Air samples are collected on a weekly basis. A composite of 13 weekly samples from each of the above locations is prepared to form a quarterly sample for each location.

2.0 QUALITY ASSURANCE

Quality assurance of the samples is met by collecting samples in accordance with the conditions and guidelines set forth in this SOP (Section 6.0).

Quality assurance of the analytical results is based on the contract laboratory's quality controls such as blanks, duplicates, and standard percent recovery. The laboratory will also follow U.S. EPA Guide SW-846 and U.S. NRC Regulatory Guides 4.14 and 4.15 when analyzing the air filter samples. The laboratory is committed to meet the LLD values for radionuclides listed in these guidance documents, and will perform re-runs on all samples not meeting these limits.

3.0 ANALYTICAL REQUIREMENTS

Each quarterly sample will be analyzed for U-Nat, Ra-226, Th-230, Pb-210 and Th-232. Results will be expressed in picocuries per milliliter (pCi/mL).

PART II STANDARD OPERATING PROCEDURES

1.0 EQUIPMENT

The equipment used in monitoring levels of particulate radionuclides consists of high volume air samplers equipped with mass flow controllers and vacuum switch controlled timers. The samplers are capable of collecting air through the sample filter at a volumetric flow rate of approximately 40 standard cubic feet per minute (scfm). The mass flow controller varies the actual air flow rate as dictated by changing temperature, filter loading, and barometric pressure to maintain a constant standard air flow rate. The actual rate is read directly from the analog gauge located on the front panel. The timer is turned off when no vacuum exists in the system, i.e., when the motor/blower assembly is disconnected or otherwise malfunctions.

Particulates are trapped on an 8 x 10-inch glass microfiber filter such as one of the following, or equivalent:

1. Whatman EPM 2000
2. Schliecher & Schuell #1 HV.

2.0 MONITORING METHODOLOGY

The air samplers are mounted on towers approximately 2 meters above ground plane. The samplers run continuously except for calibration, mechanical or electrical failure, and maintenance down time. Target flow rate will be 36 scfm.

Air filters are replaced weekly due to particulate loadings. Maximum filter use duration will be weekly unless weather conditions prohibit safe access to one or more of the air monitoring station locations.

Each filter is stamped by the manufacturer with a unique number. The blank filters are weighed to the nearest 0.0001 gram using a Sartorius Model 2432 analytical balance or equivalent. The filters are kept in manila folders inside resealable plastic bags for support during transportation to the site. The tare weight is then recorded on each filter folder along with the location, filter number, start date, and start time. This information is then input into an analytical data file on the computer. When the sampled filters are collected in the field, the stop dates and times are entered on the folder. On return from the field, the filters are again weighed and the gross weights are recorded on the folders. The weights, stop dates, and stop times are then recorded into the analytical data file that is printed off and sent to the contract laboratory.

Samples are collected continuously for approximately one week. The “loaded” filters are removed from the shut down samplers, folded, and placed in the folders in the plastic bags. If any part of the filter remains on the seal gasket, it is removed and added to the folder. The new filters are removed from their folders and placed on the vacuum head

with the filter holder frame tightened enough to seal, but not tight enough to rupture the filters. The samplers are then turned on.

Each station's filters are composited on a quarterly basis (13 weeks) by the environmental staff. The samples are forwarded, along with an analytical sheet and Chain of Custody (COC) form (provided by the contract laboratory), to the contract laboratory in sealed plastic bags.

3.0 CALIBRATION

3.1 Orifice Plate

The orifice plates shall be calibrated every year as recommended by the EPA. A certified calibration laboratory that will use the EPA or an EPA-approved method will do the calibration. Calibrations will be completed in accordance with EPA-600/4-77-027a, *The Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II – Ambient Air Specific Methods*. Calibration records are kept in the environmental files.

3.2 Sampler

Calibration of the equipment occurs during the first Monday of each month. If a non-scheduled motor replacement is necessary, the sampler is re-calibrated.

An orifice plate assembly and U-tube manometer are used for monthly calibrations.

The sampler flow rate is regulated to a standard air volume that is recorded on the field calibration sheet using 20°C. (298 K) and 29.2 inches (760 mm) of mercury as standard conditions. The top portion of the Monthly Calibration and Weekly Flow Check Worksheet (Attachment C) is completed for each air sampling station and retained in the files.

The monthly calibration task involves the following:

1. Before visiting each monitoring location, the air temperature and barometric pressure are recorded.
2. The motors are replaced as required. The replacement motors are prepared at the Mill office.
3. A filter is placed within the orifice plate, and the orifice plate is secured on top of the vacuum head.
4. The orifice plate is connected to the U-tube manometer and the initial inches H₂O is recorded and a flow rate calculated using the current field temperature and pressure.
5. The control screw is adjusted as necessary to advance or slow the vacuum motor to reach the desired flow rate. The final flow rate must be at least 32 scfm on the analog meter and reach 75% onstream time for the quarter to meet the required LLD for the radionuclide parameters.

4.0 CALCULATIONS

Using inches of water from the U-tube, refer to the following subsections to perform the calculation of flow rate. Section 4.1 provides the equation used to compute the flow rate at field conditions, and (the “actual” flow rate [Q_a]), in cubic meters per minute. Actual flow rate must be corrected to standard flow rate (Q_s) using the flow rate equation in Section 4.2. The standard flow rate is then converted to standard cubic feet with the conversion equation in Section 4.3.

4.1 Orifice Equation

Using the inches of water measurement, determined from the U-tube, the following equation is used to calculate the flow rate at field conditions:

$$Q_a = 1/m \left\{ \left[\sqrt{\Delta H \left(\frac{T_a}{P_a} \right)} \right] - b \right\}$$

Where:

Q_a = Actual flow rate at field conditions (m^3/min)

m = Slope value from Q_a portion of orifice calibration

ΔH = Manometer reading (in. H_2O)

T_a = Actual temperature ($273 + ^\circ C = K$) [from the meteorological station data (temperature readings) that are downloaded weekly]

P_a = Actual atmospheric pressure (mmHg) [from the meteorological station data (barometric pressure readings) that are downloaded weekly]

b = Intercept value from Q_a portion of orifice calibration

The constants m and b in the above equation are provided by the calibration laboratory for each specific calibrated orifice (Attachment D). Each orifice will have unique performance properties that relate to design; those measured performance properties are incorporated into the flow equation as specific constants. The flow equation demonstrates the relationship between measured vacuum pressure in inches of water to actual flow rate utilizing this device.

4.2 Standard Conditions Flow Rate Equation

The flow rate at standard conditions is calculated by adjusting the field condition flow rate, calculated above, by the following equation:

$$Q_s = Q_a \left(\frac{P_a}{P_s} \right) \left(\frac{T_s}{T_a} \right)$$

Where:

Q_s = Standard flow rate at standard conditions (m^3/min)

Q_a = Actual flow rate at field conditions (m^3/min)

T_a = Actual temperature ($273 + ^\circ C = K$)

P_a = Actual atmospheric pressure (mmHg)

T_s = Standard temperature = 298 K

P_s = Standard atmospheric pressure = 760 mmHg

4.3 Correction Equation

To convert the standard flowrate, from cubic meters per minute to standard cubic feet per minute, use the following equation:

$$Q_s \left(\frac{ft^3}{min} \right) = 35.315 \times Q_s \left(\frac{m^3}{min} \right)$$

5.0 RECORD KEEPING

The records are kept on the filter folders and the field worksheets, which are retained in the environmental files in the environmental office and are also entered into the analytical data file on the computer after the data have been reviewed. The following information will be entered into the computer data file (see Attachment E):

- Filter number
- Start date
- Stop date
- Start time
- Stop time
- Starting manometer reading (ΔH) (in. H_2O)
- Stopping manometer reading (ΔH) (in. H_2O)
- Weekly average temperature (T_a) ($^\circ C$)
- Weekly average pressure (P_a) (mmHg)
- Tare filter weight (g)
- Gross filter weight (g)

The following information will be calculated by the computer file (see Attachment E):

- Total time (min)
- Average manometer reading (ΔH) (in. H₂O)
- Weekly average temperature (K)
- Actual flow rate (Q_a) (m³/min)
- Standard flow rate (Q_s) (m³/min)
- Standard flow rate (Q_s) (ft³/min)
- Total standard volume (m³)
- Net weight (mg)
- Loading (mg/m³)
- Percent onstream

6.0 QUALITY ASSURANCE

6.1 Installation and Removal of Filters

Field methods to assure quality of air sample collection include the following:

1. Inspection of all new filters for aberrations and discarding damaged ones.
2. Maintaining seals on equipment connections.
3. Careful installation and removal of filters, retaining all abraded filter media.
4. Proper sequential handling of all filters.
5. Filters are inspected for fingerprint contamination by visual observation.

6.2 Sample Duration

Maintenance of sample duration is assured by:

1. Installation of a vacuum-actuated timer which operates the timer only when the motor is running and pulling the minimum allowable vacuum.
2. Weekly monitoring of stations and inspecting wear on the motors and proper change-out at appropriate intervals (monthly).

6.3 Sample Flow Rate

Quality assurance of each sampler's flow rate is accomplished by weekly readings of the sampler's flow characteristics using a manometer. Sampler pressure drop readings are measured on a weekly basis using a manometer and going through the monthly calibration steps. This value, along with average weekly temperature and pressure values from the site meteorological station, are used to determine weekly flow rate values. Monthly checks of flow controller operation and documentation thereof also provide quality assurance. Samplers are calibrated and checked at motor rotation intervals (monthly).

6.4 Calculations

Calculations are checked on a random basis for inconsistencies, and such checks are documented.

Upon retrieval of the data analytical sheet from the contract laboratory, the date of receipt is noted, along with the date of transcription is noted on the sample station log sheet with the transcriber's initials. The transcription of data is reviewed by another person in the Environmental Department to minimize transposition of numerical values. Calculation and data storage is by computer program.

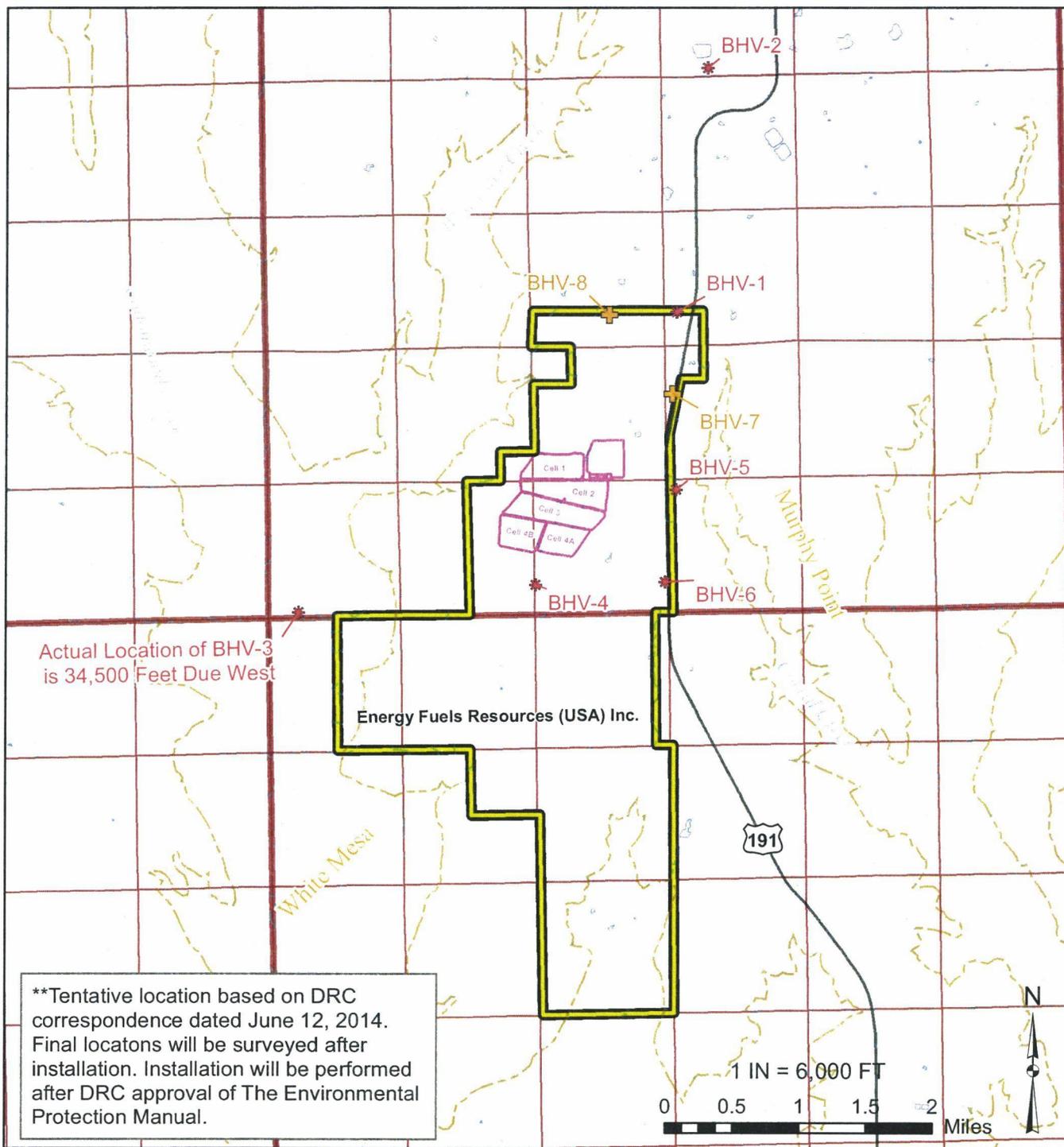
6.5 Sampler Performance

A record of sampler operation time versus total possible duration time is maintained as a flag against excessive equipment downtime. Sampler performance is reviewed monthly.

6.6 Quality Control Methodology

Blanks are weighed each week and submitted alongside the actual filters. The filters and blanks are recorded on an analytical sheet which is sent to the vendor, and this sheet is returned with the results.

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Actual Location of BHV-3 is 34,500 Feet Due West

Energy Fuels Resources (USA) Inc.

**Tentative location based on DRC correspondence dated June 12, 2014. Final locations will be surveyed after installation. Installation will be performed after DRC approval of The Environmental Protection Manual.

- Legend**
- * Existing Air Monitoring Station
 - + Tentative Air Monitoring Station**
 - - - Canyon Rim
 - - - Drainage
 - Road
 - ▭ Property Boundary
 - ▭ Tailings Cell
 - ▭ Township and Range
 - ▭ Section
 - ▭ Pond

Coordinate System: NAD
1983 StatePlane Utah
South FIPS 4303 Feet

		Project: WHITE MESA MILL	
		County: San Juan	State: Utah
REVISIONS	Date:	By:	Location: -
ATTACHMENT A			
PARTICULATE MONITORING STATIONS			
Author: mhenington	Date: 8/22/2014	Drafted By: mhenington	

**ATTACHMENT C
MONTHLY CALIBRATION AND WEEKLY FLOW CHECK WORKSHEET**

Site: _____

Orifice Plate No.: _____

Date of Calibration: _____

Calibrator's Name: _____

Temperature (T_a): _____ °C / _____ K

Pressure (P_a): _____ mmHg (25.4 x inches)

Monthly Calibration for the Month of:

Initial Manometer ⁽¹⁾ (ΔH) (in. H ₂ O)	Q _a ⁽²⁾ Actual Flow (m ³ /min)	Q _s ⁽³⁾ Standard Flow (m ³ /min)	Q _s ⁽⁴⁾ Standard Flow (ft ³ /min)	Adjusted Manometer ⁽⁵⁾ (in. H ₂ O)	Adjusted Q _s ^(2,3,4,5) (ft ³ /min)

Weekly Flow Check

Week	Filter Number	Start Date	Start Time	Starting Manometer (in. H ₂ O)	Stop Date	Stop Time	Stopping Manometer (in. H ₂ O)
1							
2							
3							
4							
5							

Orifice Information

Orifice S/N	
Q _a Slope (m)	
Q _a Intercept (b)	
Calibration Date	

Orifice Notes: Information to left found on the latest certification worksheet delivered with a newly certified orifice. Orifice should be calibrated annually. Slope and intercept values should come from Q_a portion of the calibration.

Monthly Calculations:

- 1) Connect the U-tube manometer to the orifice plate then read and record the initial pressure drop.
- 2) Use the manometer reading to calculate the actual flow rate using the Q_a equation below, which uses actual temperature and pressure as well as specific orifice values filled out above.
- 3) Convert actual flow rate to standard flow rate using the Q_s equation below.
- 4) Convert the standard flow rate from (m³/min) to (ft³/min).
- 5) If necessary, adjust the control screw so that the final flow rate is between 32-40 ft³/min.

$$(2) Q_a = 1/m \left\{ \left[\sqrt{\Delta H \left(\frac{T_a}{P_a} \right)} \right] - b \right\}$$

$$(3) Q_s = Q_a \left(\frac{P_a}{P_s} \right) \left(\frac{T_s}{T_a} \right)$$

$$(4) Q_s \left(\frac{\text{ft}^3}{\text{min}} \right) = 35.315 \times Q_s \left(\frac{\text{m}^3}{\text{min}} \right)$$

Where:

Q_a = Actual flow rate at field conditions (m³/min)
 Q_s = Standard flow rate at standard conditions (m³/min)
 m = Slope value from Q_a portion of orifice calibration
 b = Intercept value from Q_a portion of orifice calibration
 ΔH = Manometer reading (in. H₂O)
 T_a = Actual temperature (273 + °C = K)
 P_a = Actual atmospheric pressure (mmHg)
 T_s = Standard temperature = 298 K
 P_s = Standard atmospheric pressure = 760 mmHg



TISCH ENVIRONMENTAL, INC.
 145 SOUTH MIAMI AVE
 VILLAGE OF CLEVELAND, OH
 45002
 513.467.9000
 877.263.7610 TOLL FREE
 513.467.9009 FAX

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Jul 10, 2014 Rootsometer S/N 0438320 Ta (K) - 296
 Operator Tisch Orifice I.D. - 8091779 Pa (mm) - 754.38

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER	ORFICE
					DIFF Hg (mm)	DIFF H2O (in.)
1	NA	NA	1.00	1.3890	3.3	2.00
2	NA	NA	1.00	0.9870	6.4	4.00
3	NA	NA	1.00	0.8770	8.1	5.00
4	NA	NA	1.00	0.8370	9.0	5.50
5	NA	NA	1.00	0.6900	12.9	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9949	0.7163	1.4137	0.9956	0.7168	0.8859
0.9907	1.0038	1.9993	0.9914	1.0045	1.2528
0.9885	1.1271	2.2353	0.9892	1.1279	1.4007
0.9874	1.1797	2.3444	0.9881	1.1805	1.4690
0.9822	1.4235	2.8275	0.9829	1.4245	1.7717
Qstd slope (m) = 1.99700			Qa slope (m) = 1.25049		
intercept (b) = -0.01294			intercept (b) = -0.00811		
coefficient (r) = 0.99992			coefficient (r) = 0.99992		
y axis = SQRT[H2O(Pa/760)(298/Ta)]			y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

$$Vstd = \text{Diff. Vol} \left[\frac{Pa - \text{Diff. Hg}}{760} \right] (298/Ta)$$

$$Qstd = Vstd/Time$$

$$Va = \text{Diff Vol} \left[\frac{Pa - \text{Diff Hg}}{Pa} \right]$$

$$Qa = Va/Time$$

For subsequent flow rate calculations:

$$Qstd = 1/m \left\{ \left[\text{SQRT} \left(\text{H2O} \left(\frac{Pa}{760} \right) \left(\frac{298}{Ta} \right) \right) \right] - b \right\}$$

$$Qa = 1/m \left\{ \left[\text{SQRT} \left(\text{H2O} \left(\frac{Ta}{Pa} \right) \right) \right] - b \right\}$$



TISCH ENVIRONMENTAL, INC.
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ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Jul 21, 2014 Rootmeter S/N 0438320 Ta (K) - 299
 Operator Tisch Orifice I.D. - 5-76-02 Pa (mm) - 754.38

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORIFICE DIFF H2O (in.)
1	NA	NA	1.00	1.3950	3.2	2.00
2	NA	NA	1.00	0.9800	6.4	4.00
3	NA	NA	1.00	0.8780	8.1	5.00
4	NA	NA	1.00	0.8370	8.9	5.50
5	NA	NA	1.00	0.6860	12.9	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9851	0.7061	1.4066	0.9957	0.7138	0.8903
0.9808	1.0008	1.9893	0.9914	1.0116	1.2591
0.9786	1.1146	2.2241	0.9892	1.1266	1.4077
0.9776	1.1680	2.3326	0.9882	1.1806	1.4765
0.9723	1.4174	2.8132	0.9829	1.4328	1.7807
Qstd slope (m)	=	1.98285	Qa slope (m)	=	1.24163
intercept (b)	=	0.00883	intercept (b)	=	0.00559
coefficient (r)	=	0.99986	coefficient (r)	=	0.99986
y axis = SQRT[H2O(Pa/760)(298/Ta)]			y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

$$Vstd = \text{Diff. Vol} [(Pa - \text{Diff. Hg}) / 760] (298 / Ta)$$

$$Qstd = Vstd / \text{Time}$$

$$Va = \text{Diff Vol} [(Pa - \text{Diff Hg}) / Pa]$$

$$Qa = Va / \text{Time}$$

For subsequent flow rate calculations:

$$Qstd = 1/m \{ [\text{SQRT}(\text{H2O}(\text{Pa}/760)(298/\text{Ta}))] - b \}$$

$$Qa = 1/m \{ [\text{SQRT}(\text{H2O}(\text{Ta}/\text{Pa}))] - b \}$$

BHV-1	Energy Fuels Resources - White Mesa Mill Period: July 1, 2014 - September 30, 2014										Calibration Date: 7/10/2014 Calibration Slope & Intercept: m= 1.25049 b= -0.0081 Orifice S/N: 8091779					Updated: 8/22/14				
--------------	---	--	--	--	--	--	--	--	--	--	---	--	--	--	--	------------------	--	--	--	--

Week #	Filter Number	Start Date	Stop Date	Start Time	Stop Time	Total Time (min)	ΔH Starting Manometer (in. H ₂ O)	ΔH Stopping Manometer (in. H ₂ O)	ΔH Average Manometer (in. H ₂ O)	Ta Wkly. Avg. Temp. (°C)	Ta Wkly. Avg. Temp. (K)	Pa Wkly. Avg. Pressure (mmHg)	Qa Act. Flow (m ³ /min)	Qs Std. Flow (m ³ /min)	Qs Std. Flow (SCFM) (ft ³ /min)	Total Std. Volume (m ³)	Tare Weight (g)	Gross Weight (g)	Net Weight (mg)	Loading (mg/m ³)	Percent Onstream (%)
1	7130505	7/7/2014	7/14/2014	7278.3	17366.2	10087.9	4.0	4.0	4.0	19.0	292.2	621.03	1.10	0.92	32.48	9278.3	4.4442	4.4905	46.3	0.0050	100.1
2	7123199			17366.2	27408.8	10042.6	3.5	3.6	3.6	20.0	293.2	621.03	1.04	0.87	30.56	8689.7	4.5221	4.5319	9.8	0.0011	99.6
3	7129193			27408.8	37640.7	10231.9	4.0	3.5	3.8	20.0	293.2	621.03	1.07	0.89	31.40	9098.0	4.5172	4.5218	4.6	0.0005	101.5
4	7129187			37640.7	47869.5	10228.8	3.0	3.9	3.5	20.0	293.2	621.03	1.03	0.85	30.13	8726.1	4.5303	4.5360	5.7	0.0007	101.5
5				47869.5	57734	9864.5	3.5	4.0	3.8	20.0	293.2	621.03	1.07	0.89	31.40	8771.3	4.5295	4.5380	8.5	0.0010	97.9
6				57734	67754.2	10020.2	4.0	3.8	3.9	20.0	293.2	621.03	1.09	0.91	32.02	9085.1	4.5402	4.5464	6.2	0.0007	99.4
7				67754.2	77803.4	10049.2	3.6	3.9	3.8	20.0	293.2	621.03	1.07	0.89	31.40	8935.5	4.5359	4.5435	7.6	0.0009	99.7
8				77803.4	83387.6	5584.2	3.7	3.6	3.7	20.0	293.2	621.03	1.06	0.88	30.98	4899.1	4.5536	4.5610	7.4	0.0015	55.4
9				83387.6	93412.4	10024.8	3.8	4.0	3.9	20.0	293.2	621.03	1.09	0.91	32.02	9089.3	4.5542	4.5605	6.3	0.0007	99.5
10				93412.4	103434.8	10022.4	4.0	4.0	4.0	20.0	293.2	621.03	1.11	0.92	32.42	9202.2	4.5613	4.6928	131.5	0.0143	99.4
11				103434.8	113555.1	10120.3	3.5	3.6	3.6	20.0	293.2	621.03	1.04	0.87	30.56	8757.0	4.5489	4.5543	5.4	0.0006	100.4
12				17921.6	27945.8	10024.2	3.6	3.8	3.7	20.0	293.2	621.03	1.06	0.88	31.19	8854.0	4.5355	4.5454	9.9	0.0011	99.4
13				27945.6	38066.3	10120.7	3.7	4.0	3.9	20.0	293.2	621.03	1.08	0.90	31.81	9117.6	4.5355	4.5454	9.9	0.0011	100.4
Totals						126421.7							13.92	11.56	408.38	112503.2	58.908	59.168	259.1	0.0291	
Averages						9724.7	3.7	3.8	3.8	19.9	293.1	621.03	1.07	0.89	31.41	8654.1	4.531	4.551	19.9	0.0022	96.5

Comments:
 Insert weekly flow check values in yellow columns.
 Blue column values are calculated.
 Green columns are calculated averages from the met station.
 Insert filter weight values into orange columns.

ATTACHMENT E

AIR MONITORING -- RADON

1. RADON MONITORING PLAN

1.1 Locations and Frequency of Samples

Radon samples are taken at the following locations:

BHV-1

BHV-2

BHV-2A (Duplicate of BHV-2)

BHV-3 (Background location for use in assessment of background concentrations)

BHV-4

BHV-5

BHV-6

BHV-7

BHV-8

BHV-70 (Blank sample for use in assessment of effects due to sample shipment. Previously numbered as BHV-7)

See Attachment A to Section 1.1 of this Environmental Protection Manual for the locations of these monitoring stations.

Samples are collected on a quarterly basis using Radtrak® (Trac-Etch) Outdoor Air Radon Detector, (Landauer Part Number DRNM) or equivalent. One or more than one Radtrak® (Trac-Etch) Outdoor Air Radon Detector will be placed at each of the locations noted above (except BHV-70). The number of detectors to be placed at each location shall be as determined by the Radiation Safety Officer (“RSO”). If multiple Radtrak® detectors are placed at one location, the numeric average of the results for that location will be calculated and reported as the radon value for the quarter.

Radtrak® (Trac-Etch) detector results will be reported in the Semi-Annual Effluent Report.

1.2 Quality Assurance

Quality assurance of the samples is met by collecting samples in accordance with the conditions and guidelines set forth in Section 2 of this procedure. In addition, the following steps will be followed:

- a) One duplicate sample or set of duplicate samples will be collected each quarter by placing samples at the same location as the routine sample(s), at the same height as the routine sample(s), and as close to the routine sample(s) as reasonably achievable;

- b) A field blank sample will be collected each quarter to assess any concentrations resulting from shipment of the detectors;
- c) Detector locations will be monitored periodically to ensure the detectors have not been lost;
- d) Detector shipments will be inspected to ensure that all detectors are present when receiving or shipping detectors; and
- e) Monitoring data will be reviewed for consistency and data transportation issues/detections.

1.3 Analytical Requirements

Each quarterly sample will be analyzed for Radon-222. Results will be expressed in pCi/L.

2. STANDARD OPERATING PROCEDURES

2.1 Equipment

Samples will be collected using the Radtrak® (Trac-Etch) Outdoor Air Radon Detector (Landauer Part Number DRNM) or equivalent. The detectors will be returned to the supplier/manufacturer for processing and analysis. Detectors are analyzed using the “high sensitivity” methodology, which provides a lower limit of detection of 6.0 pCi/L-days.

2.2 Monitoring Methodology

The following monitoring procedures will be followed:

- a) Remove detector from package – The Radtrak® radon detectors are supplied in aluminum bags which prevent radon exposure. Open the aluminum bag and remove the clear plastic cup which has a Radtrak® detector fastened to the bottom. Detectors, before, during or after exposure should not be in locations which exceed a temperature of 160°F (70°C). There is no low temperature.
- b) Fill in the enclosed Detector Log Sheet with the serial number on the detector label. Also fill in the date installed and the location information in the location/comments area.
- c) Attach a field canister to a post or other location using the metal bracket with the open mouth of the canister facing down. The canister may be placed at any desired height (typically 3-6 feet) and preferably in a location minimizing animal damage or tampering. Remove the clear acrylic retaining ring from the canister by removing the wing nuts. Install the assembled cup inside the canister and replace the retaining ring and wing nuts in order to hold the cup in place.

- d) Leave the detectors undisturbed for the duration of the three month monitoring period.
- e) At the end of the monitoring period, remove the Radtrak® detector from the plastic cup. Peel off the gold seal provided with the shipment and cover all the holes on the top of the detector. This stops the monitoring period. Record the ending date on the Detector Log Sheet.
- f) After all of the detectors have been collected and sealed, but prior to final packaging and shipment, open a new detector and immediately cover all the holes on the top of the detector with one of the gold seals provided with the shipment. Label this detector as BHV-70 on the Detector Log Sheet. Use the same exposure time/days for BHV-70 as the eight sample detectors when listing BHV-70 on the Detector Log Sheet.
- g) Return the detectors along with a copy of the Detector Log Sheet using the laboratory provided label for shipment back to the supplying organization.

3. RECORD KEEPING

Data maintained in record form for environmental radon is:

- a) Sample period;
- b) Sample location; and
- c) Radon levels.

STACK EMISSION MONITORING PROCEDURES

WHITE MESA GAS STACK EMISSIONS

1.0 INTRODUCTION

White Mesa, or it's contracted service providers, uses scientifically approved reference methods to determine gas stack emissions release concentration for radionuclide particulates. These methods conform to principles that apply to obtaining valid samples of airborne radioactive materials, using prescribed acceptable methods and materials for gas and particulate sampling. See American Standard Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities ANSI N13.1-1969. These sampling methods are also consistent with guidance contained in the U.S. Nuclear Regulatory Commission's Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills."

2.0 SAMPLING METHODOLOGIES

The sampling methods for airborne radionuclide particulates, from the yellowcake dryer and other mill effluent control stacks, are identical to methods published in the EPA's manual, Gas Stream Sampling Reference Methods for New Source Performance Standards; they are found in the EPA Manual in Appendix No. 5, "Determination of Particulate Emissions from Stationary Sources" ("EPA Method #5") and Appendix No. 17, "Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)" ("EPA Method #17). Copies of EPA Method #5 and #17 are attached to this SOP. Sampling is performed as per the methods, to ensure that the sampling and results are: (1) isokinetic; (2) representative; and (3) adequate for determination of the release rates and concentrations of U-Nat, Th-230, Ra-226 and Pb-210.

2.1 Sampling Equipment

Sampling equipment used to collect airborne radionuclide particulates from point source emission stacks at the Mill consists of equipment manufactured by Research Appliance Company (RAC), (or other equivalent apparatuses), as follows:

1. RAC Model 201009 Model 2414 stack sampler.
2. Two each, RAC Model 201044 modular sample cases. One heater box and one glassware box.
3. One each, RAC Model 201019 umbilical cord.

4. Three each, RAC Model 201013 – 100mm diameter filter holders.
5. One each, RAC Model 201005 standard pilot tube, three feet length, stainless steel/S-type probe.
6. Barometer.
7. Psychrometer.
8. Satorius Model 2432 balance or equivalent.
9. Triple beam balance.

Equipment instruction and operating manual(s) provided by the manufacturer(s) are retained at the Mill and used for specific guidance and reference.

2.2 Sample Collection

Gas stack samples are collected from emission control systems used in Recovery Operations at the Mill. These samples are collected from process stacks when the emission control systems are operating. They are sampled for radionuclide particulate concentrations at a frequency in accordance with Table 5-1. Sample collection methods are described in detail in EPA Method #5 and EPA Method #17, Determination of Particulate Matter Emissions From Stationary Sources. It is necessary to read and understand all procedures described in the methods and in the equipment manual. The operation of the equipment requires “hands-on” instruction from the Environment Departmental Staff from individuals who are experienced in using sample collection equipment and applying sample collection methods. The following steps are described for stack sample collection.

1. Check equipment listed in Section 2.1 of this SOP. Consult the manufacturers equipment operations manual for details.
2. Assemble equipment as described in the operations manual for sample collection EPA Method #17.
3. Follow the calibration procedure listed in the manual. If the calibration measurements are not obtained, consult the trouble shooting section of the manual for corrective instruction. Once the collection apparatus is calibrated, proceed to the next step.
4. Weigh a new glass fiber filter, record the weight, and place in the filter holder assembly.
5. Check the sample collection system for leaks.
6. Cap ends of sample probes to prevent contamination and transport sample unit to the sample location.
7. Uncap sample end and insert 3/8-diameter sample probe into the stack in the midsection of the exhaust stream.
8. Turn sample apparatus on and observe unit operation to insure a sample is being collected and the apparatus is functioning properly.
9. Collect the stack sample for at least one hour during periods of routine process operation. Note the collection time.

10. Record the information described in the manufacture's operations manual. This information is also described in the EPA Methods #5 and #17 for point source particulate emissions.
11. After sample collection is complete, turn off unit. Obtain sample filter from filter housing and place in a new plastic petri dish. Send to outside laboratory for radionuclide analysis in accordance with Table 5-1.

2.3 Sample Handling and Shipping

1. During preparation and assembly on the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.
2. Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.
3. Before moving the sampling train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened, and cap it. Remove the umbilical cord from the last impinger, and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder, and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.
4. Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.
5. Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used, and place it in a glass sample container labeled "acetone blank."
6. Carefully remove the filter from the filter holder, and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the PM cake is inside the fold. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to the petri dish and PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.
7. Send to the laboratory for radionuclide analysis.

3.0 RECORD KEEPING

Records of gas stack effluent sampling events and results of analysis are retained at the Mill. The following information is recorded:

1. Stack and Run ID
2. Date and Sampler
3. Sampled Air Volume at standard conditions
4. Sampled Water Volume at standard conditions
5. Moisture Content (volume basis)
6. Stack Gas Molecular Weight (wet basis)
7. Stack Gas Velocity
8. Stack Gas Volumetric Flow Rate (dry basis, at standard conditions)
9. Particulate Concentration
10. Percent Isokinetics
11. Emission Rates for Particulates U-Nat, Th-230, Ra-226, and Pb-210.

The data are used to calculate emission rates in pounds and pico curies per hour for radionuclide particulate concentrations.

4.0 MONITORING LOCATION AND FREQUENCY

Stack sampling must be performed during any quarter or semi-annual period that the stacks operate in accordance with the schedule in Table 5-1. During non-operational periods, stack sampling is not performed.

4.1 Yellowcake Stacks

The exhaust stack for the drying and packaging equipment associated with the yellowcake calciner is sampled on a quarterly basis during operations. The sample ports are located on the roof of the main Mill building.

4.2 Feed Stacks

The grizzly feed stack is located on the north end of the grizzly structure. This stack is accessible from a stack platform and is sampled quarterly if this system is operating.

4.3 Vanadium Stacks

The exhaust stack for the drying and packaging equipment associated with the vanadium circuit is sampled on a quarterly basis during operations. The sample ports are located on the roof of the vanadium annex portion of the building.

5.0 ANALYSIS REQUIREMENTS

All gas stack samples are collected at the Mill according to the calendar year schedule shown below in Table 5-1. The samples will be sent to an off-site laboratory for the analysis detailed below.

TABLE 5-1
Sampling Frequency and Analysis

Frequency	Grizzly Baghouse Stack	North and/or South Yellowcake Dryer Stacks	Yellowcake Packaging Baghouse Stack	Vanadium Dryer Stack	Vanadium Packaging Stack
Quarterly	If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.	If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.	If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.	If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.	If operating, U-nat, Th-230, Ra-226, Pb-210, Th-232, Ra-228, and Th-228.

Note: Grizzly baghouse stack and Vanadium Circuit stack samples shall be representative and adequate (based on EFRI's operational knowledge and operational conditions at the time of the sampling event) for the determination of the release rates and concentrations of radionuclides listed in Table 5-1 above, and do not need to be collected in an isokinetic state.

6.0 QUALITY ASSURANCE METHODOLOGY

6.1 Equipment Operation

Prior to performing an emission point sampling run, the sampling equipment is subjected to a dry run test to determine leakages or equipment malfunction. Calibration of equipment is checked on a periodic basis. Probe tips are protected by a protective cap while not in use to protect accuracy determinations. During transport of equipment, all openings are sealed to prevent contamination. Calculations utilized during runs to maintain isokinetic conditions are reviewed and dry run tested prior to the actual run. All containers and probes are washed prior to each usage.

Malfunction of sampling equipment, excessive malfunctions of normal operations being monitored, or percent isokinetic sampling rates greater than $\pm 10\%$ error, indicate mandatory voiding of the run or data involved.

6.2 Operations

If samples are collected from the operation of any unit which appears, in the judgment of the sampler, to be functioning in a manner not consistent with normal operations, then the sample will be voided and the system will be resampled.

6.3 Chemical Sample Control

Analyses on each period's sample shall include blanks for the filters, impinger solutions, and the rinse solutions. A field logbook shall be maintained listing data generated, determinations of volumes measured, and net gain weights of filters to provide a back up to summary data records. Filters are transmitted within plastic enclosed petri dishes. Handling of filters is only done using tweezers.

6.4 Calculations

All calculations will be retained at the Mill in both a hard copy and computer files.

The gas stack effluent concentrations (C) are calculated as follows:

$$\text{Lab Result } \mu\text{Ci (A)} / \text{Volume Sampled (V)} = \text{Effluent Concentration (C)}$$

where

$$\text{Volume Sampled (V)} = \text{Flow rate (Q)} * \text{Time of sample collection in minutes (t)}$$

and

$$\text{Lab Result } \mu\text{Ci (A)} = \text{Radioisotopic activity, in } \mu\text{Ci on air filter}$$

SURFACE SOIL MONITORING

PART I SOIL MONITORING PLAN

1.0 SOIL MONITORING

Surface soils are sampled at the eight air monitoring sites and at spaced intervals around the perimeter boundary of the Mill property. The sampling locations are shown in Figure 1. Soil samples from the northern Mill boundary and the north half of the eastern boundary (adjacent to Sections 22, 27 and 34) are collected approximately every 1000 feet. The remainder of the perimeter boundary soil samples are collected every 2500 feet. Soil samples are taken once per year during August or as soon as possible thereafter, but no later than September 30 of the year. Each soil sampling location will be marked with an aluminum tag with the sample location identification etched or painted on the tag. The tags will be attached to a metal stake driven approximately 18 inches into the ground. The sampling locations will be placed on the inside of the Mill's perimeter fence to prevent tampering and vandalism. The locations will be sited approximately one foot from the inside of the perimeter fence to prevent inadvertent disturbance by truck or vehicle traffic. The location markers will be designed and installed with as low a profile as possible, while still maintaining visibility for ease of location during the annual sampling program.

In addition, a soil sample could be taken from Westwater Creek, in the place of a water sample. However, a sediment (soil) sample would only be taken at Westwater Creek if water was not available. In the event that a soil sample is collected in place of a water sample for Westwater Creek, the sample should be analyzed for the same parameters as those called for in this SOP (Radium-226 and U-nat). Refer to SOP No. PBL-EP-3 for details regarding collection of a water sample from Westwater Creek.

2.0 SAMPLING AND ANALYTICAL QUALITY ASSURANCE

The sample bags are marked for location identification and are submitted to the analytical laboratory accompanied by Chain-of-Custody forms. (Attachment A)

Analytical quality assurance for soil monitoring is based on the contract laboratory's quality controls such as blanks, duplicates, and standard percentage recovery. The laboratory is committed to meet the LLD values for radionuclides contained in U.S. NRC Regulatory Guides 4.14 and 4.15 and will perform re-runs on all samples not meeting these limits. Appropriate laboratory control and quality assurance data will be provided by the contract laboratory, or equivalent, including LLD information.

3.0 ANALYTICAL REQUIREMENTS

All soil samples will be analyzed, on a dry basis for the following radionuclides: Ra-226 Th-232, Pb-210, and U-Nat. Analytical results will be reported in appropriate radiological units such as pico curies per gram or micro curies per kilogram.

PART II SOIL MONITORING STANDARD OPERATING PROCEDURES

1.0 SURFACE SOIL SAMPLING

1.1 Equipment

Equipment used for soil sampling is as follows:

1. Tape measure or measuring stick calibrated to 1 foot and to one centimeter.
2. Clean trowel or shovel.
3. Clean sample containers.

1.2 Soil Sampling Procedure

Soil samples are collected using a clean trowel or shovel to excavate a soil sample evenly across a one square foot area at a depth of one centimeter. The one centimeter excavation depth is maintained by using the tape measure or other suitable calibrated measuring stick. As the soil is being collected, it is placed directly into the sample container. The sample container is then identified with a label (see Section 2.1 below).

2.0 SAMPLING QUALITY ASSURANCE

2.1 Sample Duplicates

Soil sample duplicates will be collected at a frequency of 1 duplicate per 20 samples. The duplicates will be submitted blind to the laboratory and will be named as follows:

N1D where:

N = Northern boundary

1 = Sequential number of the northern boundary sample

D = Duplicate of sample N1

Duplicate precision will be discussed in the Semi-Annual Effluent Report. Duplicate precision will be assessed as follows:

- a) Relative Percent Difference.

RPDs will be calculated in comparisons of duplicate and original field sample results. Section 3.3 will apply when the RPD $\geq 35\%$, unless the measured concentrations are less than 5 times the required detection limit (Standard Methods, 1998) (EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February 1994, 9240.1-05-01, p. 25).

2.2 Sample Labeling

Each sample must be labeled and all sample labels must be filled out in ink and numbered. The following information must be contained on the label:

1. Project and facility.
2. Company name
3. Date and time of sample collection.
4. Sampler's initials.
5. Sample location.
6. Requested Analytical Parameters

2.2 Sample Chain-of-Custody

During sampling activities, traceability of the sample must be maintained upon sample collection until the laboratory data is issued. Information on the custody, handling, transfer, and shipment of the samples will be recorded on a Chain-of-Custody form (COC). The sampler is responsible for filling out the COC form. The COC form will be signed by the sampler when the sampler relinquishes the samples to anyone else. A COC form is to be completed for each set of samples placed in a sample shipping container and is to include the following:

1. Sampler's name.
2. Date and time of collection.
3. Sample location.
4. Sample type.
5. Analysis requested.
6. Signatures of persons releasing custody.
7. Signatures of persons accepting custody, dates, and times.

Copies of the COC forms and all custody documentation when received will be retained in appropriate files at the Mill. The original COC form remains with the samples until disposal of the samples.

2.3 Sample Handling and Shipping

Samples will be placed in shipping containers and transported to the contract laboratory. COC forms will be placed inside a resealable bag and placed inside the sample shipping container.

2.4 Record Keeping

All soil sample data are retained in the files and when analytical results are available the results are entered into a computer file and retained in the files. Laboratory analytical data are stored in the soil files after the data has been entered on a computer file.

3.0 ANALYTICAL QUALITY ASSURANCE

3.1 Data Validation and Quality Control

Laboratory analyses will be reviewed by the technical staff and any identifiable anomalies in results noted and investigated. Appropriate measures to confirm or disaffirm results will be pursued, such as laboratory conversation, analytical sample rerun, or trend analysis.

3.2 Quality Assurance and Data Validation

The contract laboratory will prepare and retain a copy of all analytical and quality control documentation. The laboratory will provide hard copy information in each data package submitted in accordance with quality assurance objectives for the surface soil quality assurance project plan that is: COC forms, cover sheets with comments, narratives, samples analyzed, reporting limits and LLD values for analytes, and analytical results of quality control samples. The data reduction and laboratory review will be documented, signed, and dated by the analyst.

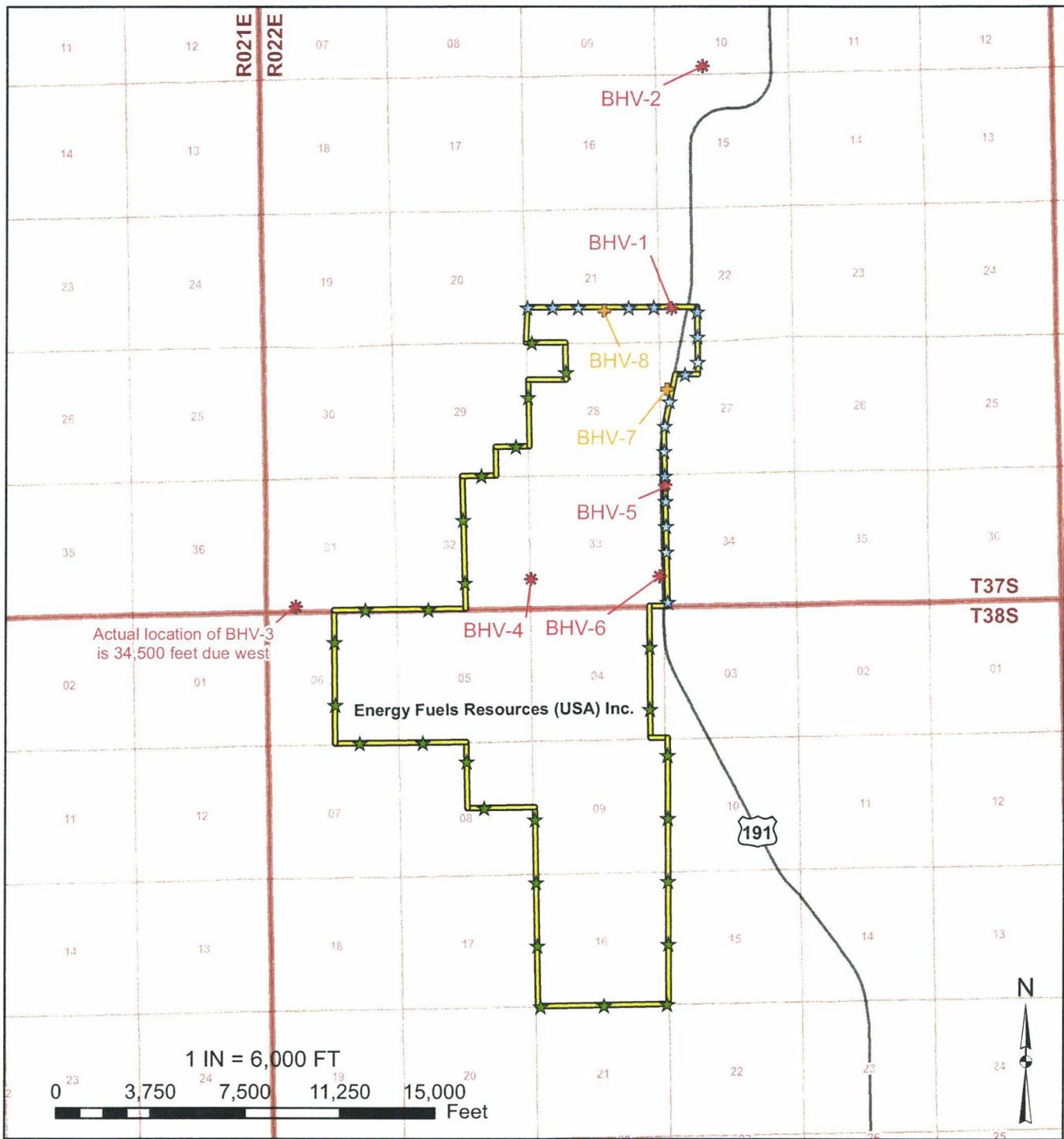
3.3 Corrective Action

Corrective action will be taken for any deficiencies or deviations noted in the procedures or anomalous results, such as but not limited to additional sample collection, sample re-run, laboratory inquires, or other actions as appropriate.

Corrective actions for duplicate deviations shall first determine if the deviation is indicative of a systematic issue. If the deviation is limited in scope and nature, the QA Manager will:

1. Notify the laboratory,
 - a. Request the laboratory review all analytical results for transcription and calculation errors, and
 - b. If the samples are still within holding time, the QA Manager may request the laboratory re-analyze the affected samples.

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Legend

Program

- ★ 1,000 Feet
- ★ 2,500 Feet
- ✱ Existing Air Monitoring Station
- ✱ Tentative Air Monitoring Station
- Property Boundary
- Road
- Township and Range
- Section

Coordinate System: NAD
1983 StatePlane Utah
South FIPS 4303 Feet



ENERGY FUELS

REVISIONS		Project: WHITE MESA MILL	
Date:	By:	County: San Juan	State: Utah
		Location: -	
<p>FIGURE 1</p> <p>SOIL MONITORING LOCATIONS</p>			
		Author: mhenington	Date: 9/5/2014
		Drafted By: mhenington	

VEGETATION MONITORING

PART I VEGETATION MONITORING PLAN

1.0 VEGETATION MONITORING PLAN

Vegetation is sampled in early spring, late spring, and late fall at three locations around the Mill. These locations are: Northeast Area (near BHV-1), Northwest Area (½ mile west of BHV-1) and the Southwest Area (West of BHV-4 and south off Cell 3).

2.0 QUALITY ASSURANCE

Quality assurance for vegetation monitoring is based on the contract laboratory's quality controls such as duplicates, blanks, standard percent recovery, and spike percent recovery. The laboratory will also follow U.S. EPA Guide SW-846 and U.S. NRC Regulatory Guides 4.14 and 4.15 when analyzing the vegetation samples. The laboratory is committed to meet the LLD values for radionuclides addressed in these guidelines and will perform re-runs on all samples not meeting these limits.

3.0 ANALYTICAL REQUIREMENTS

Each vegetation sample will be analyzed for Ra-226, U-Nat, Th-232, and Pb-210 radionuclide concentrations. Results will be expressed in units of picocuries per gram (pCi/g) or micro curies per kilogram ($\mu\text{Ci/kg}$), on a wet basis.

PART II VEGETATION MONITORING STANDARD OPERATING PROCEDURES

1.0 VEGETATION SAMPLING

1.1 Equipment

Equipment used for vegetation sampling is as follows:

1. Scissors
2. Large plastic sample bags

1.2 Vegetation Sampling Procedure

Vegetation samples are collected and removed at the surface with scissors at each sampling location. The vegetation sample is enclosed in a large plastic bag. Each sample will be weighed upon return to the office and must weigh at least three kilograms in order for the

laboratory to meet the required LLD values outlined in U.S. NRC Regulatory Guide 4.14. In addition, as vegetation samples are collected efforts will be made to minimize the amount of soil in the samples. The sample bag is then labeled (see Section 2.1).

2.0 SAMPLING QUALITY ASSURANCE

2.1 Sample Labeling

All sample labels must be filled out in waterproof ink and numbered. The date, time, sampler's initials, and the sample location will be completed at the time the sample is collected. The following information will be included on the label:

1. Project and facility.
2. Sampler's company affiliation.
3. Date and time of sample collection.
4. Sampler's initials.
5. Sample location.
6. Weight of sample.
7. Requested analytical parameters.

2.2 Sample Chain-of-Custody

During sampling activities, traceability of the sample must be maintained upon sample collection until the laboratory data is issued. Information on the custody, handling, transfer, and shipment of the samples will be recorded on a Chain-of-Custody form (COC). The sampler is responsible for filling out the COC form. The COC form will be signed by the sampler when the sampler relinquishes the samples to anyone else. A COC form is to be completed for each set of samples placed in a shipping container and is to include the following:

1. Sampler's name.
2. Date and time of collection.
3. Sample location.
4. Sample type.
5. Analysis requested.

6. Signatures of persons releasing custody.
7. Signatures of persons accepting custody, dates, and times.

Copies of the COC forms and all custody documentation when received will be retained in appropriate files at the Mill. The original COC form remains with the samples until analysis of the samples. After sample analysis, the COC form will be sent to the Environmental Department along with the analyses.

2.3 Sample Handling and Shipping

Sample bags will be packaged in large shipping boxes and transported to the contract laboratory. COC forms will be placed inside a sealed bag and placed inside the shipping box.

2.4 Record Keeping

All vegetation sampling data will be retained in a file. When analytical data becomes available, the data is entered into a computer file and retained in the files. All laboratory analytical data is stored in the vegetation files after the data has been entered into the computer file.

3.0 ANALYTICAL QUALITY ASSURANCE

3.1 Data Validation and QC Review

Laboratory analyses will be reviewed by the technical staff and any identifiable anomalies in results noted and investigated. Appropriate measures to confirm or disaffirm results will be pursued, such as laboratory conversation, analytical sample rerun, or trend analysis.

3.2 Quality Assurance and Data Validation

The contract laboratory will prepare a copy of and retain all analytical and QC documentation. The laboratory will provide the Mill with paper copies of the following in each data package, in accordance with QA objectives for the Surface Soil QA Project Plan:

1. COC forms
2. Cover sheets with comments
3. Narrative
4. Samples analyzed
5. Reporting limits and LLD values for analytes
6. Analytical results of QC samples

The data reduction and laboratory review will be documented, signed, and dated by the

contract laboratory analyst.

3.3 Corrective Action

Corrective action will be taken for any deficiencies or deviations noted in the procedures or anomalous results, such as but not limited to additional sample collection, sample re-run, laboratory inquires, or other actions as appropriate.

ATTACHMENT B

code of federal regulations

Protection of Environment

REGULATIONS FOR IMPLEMENTING STATE AIR
QUALITY STANDARDS AND FEDERAL AIR QUALITY
AND RESEARCH ACTS

40

PARTS 50 TO 51

Revised as of July 1, 1998

CONTAINING
A CODIFICATION OF DOCUMENTS
OF GENERAL APPLICABILITY
AND FUTURE EFFECT

AS OF JULY 1, 1998

With Ancillaries

Published by
the Office of the Federal Register
National Archives and Records
Administration

as a Special Edition of
the Federal Register



flow rate interval (1.1 to 1.7 m³/min [39-60 ft³/min]), are required.

9.2.6 Measure and record the certification data on a form similar to the one illustrated in Figure 4 according to the following steps.

9.2.7 Observe the barometric pressure and record as P₁ (item 8 in Figure 4).

9.2.8 Read the ambient temperature in the vicinity of the standard volume meter and record it as T₁ (item 9 in Figure 4).

9.2.9 Start the blower motor, adjust the flow, and allow the system to run for at least 1 min for a constant motor speed to be attained.

9.2.10 Observe the standard volume meter reading and simultaneously start a stopwatch. Record the initial meter reading (V_i) in column 1 of Figure 4.

9.2.11 Maintain this constant flow rate until at least 3 m³ of air have passed through the standard volume meter. Record the standard volume meter inlet pressure manometer reading as ΔP (column 5 in Figure 4), and the orifice manometer reading as ΔH (column 7 in Figure 4). Be sure to indicate the correct units of measurement.

9.2.12 After at least 3 m³ of air have passed through the system, observe the standard volume meter reading while simultaneously stopping the stopwatch. Record the final meter reading (V_f) in column 2 and the elapsed time (t) in column 3 of Figure 4.

9.2.13 Calculate the volume measured by the standard volume meter at meter conditions of temperature and pressures as V_m = V_f - V_i. Record in column 4 of Figure 4.

9.2.14 Correct this volume to standard volume (std m³) as follows:

$$V_{std} = V_m \frac{P_1 - \Delta P}{P_{std}} \frac{T_{std}}{T_1}$$

where:

V_{std} = standard volume, std m³;

V_m = actual volume measured by the standard volume meter;

P₁ = barometric pressure during calibration, mm Hg or kPa;

ΔP = differential pressure at inlet to volume meter, mm Hg or kPa;

P_{std} = 760 mm Hg or 101 kPa;

T_{std} = 298 K;

T₁ = ambient temperature during calibration, K.

Calculate the standard flow rate (std m³/min) as follows:

$$Q_{std} = \frac{V_{std}}{t}$$

where:

Q_{std} = standard volumetric flow rate, std m³/min

t = elapsed time, minutes.

Record Q_{std} to the nearest 0.01 std m³/min in column 6 of Figure 4.

9.2.15 Repeat steps 9.2.9 through 9.2.14 for at least four additional constant flow rates, evenly spaced over the approximate range of 1.0 to 1.8 std m³/min (35-64 ft³/min).

9.2.16 For each flow, compute

$$\bullet \Delta H (P_1/P_{std})(298/T_1)$$

(column 7a of Figure 4) and plot these value against Q_{std} as shown in Figure 3a. Be sure to use consistent units (mm Hg or kPa) for barometric pressure. Draw the orifice transfer standard certification curve or calculate the linear least squares slope (m) and intercept (b) of the certification curve:

$$\bullet \Delta H (P_1/P_{std})(298/T_1)$$

= mQ_{std} + b. See Figures 3 and 4. A certification graph should be readable to 0.02 std m³/min.

9.2.17 Recalibrate the transfer standard annually or as required by applicable quality control procedures. (See Reference 2.)

9.3 Calibration of sampler flow indicator.

NOTE: For samplers equipped with a flow controlling device, the flow controller must be disabled to allow flow changes during calibration of the sampler's flow indicator, or the alternate calibration of the flow controller given in 9.4 may be used. For samplers using an orifice-type flow indicator downstream of the motor, do not vary the flow rate by adjusting the voltage or power supplied to the sampler.

9.3.1 A form similar to the one illustrated in Figure 5 should be used to record the calibration data.

9.3.2 Connect the transfer standard to the inlet of the sampler. Connect the orifice manometer to the orifice pressure tap, as illustrated in Figure 3b. Make sure there are no leaks between the orifice unit and the sampler.

9.3.3 Operate the sampler for at least 5 minutes to establish thermal equilibrium prior to the calibration.

9.3.4 Measure and record the ambient temperature, T₂ and the barometric pressure, P₂, during calibration.

9.3.5 Adjust the variable resistance or, if applicable, insert the appropriate resistance plate (or no plate) to achieve the desired flow rate.

9.3.6 Let the sampler run for at least 2 min to re-establish the run-temperature conditions. Read and record the pressure drop across the orifice (ΔH) and the sampler flow rate indication (I) in the appropriate columns of Figure 5.

9.3.7 Calculate $\bullet \Delta H (P_2/P_{std})(298/T_2)$ and determine the flow rate at standard conditions (Q_{std}) either graphically from the certification curve or by calculating Q_{std} from the least square slope and intercept of the transfer standard's transposed certification curve: Q_{std} = 1/m $\bullet \Delta H (P_2/P_{std})(298/T_2)$ - b. Record the value of Q_{std} on Figure 5.

C_{TSP} = concentration at standard conditions, $\mu\text{g}/\text{std m}^3$;

P_1 = average barometric pressure during sampling period, mm Hg;

P_{std} = 760 mm Hg (or 101 kPa);

T_1 = average ambient temperature during sampling period, K.

11.0 References.

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2. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods. EPA-600/4-77-027a, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, 1977.

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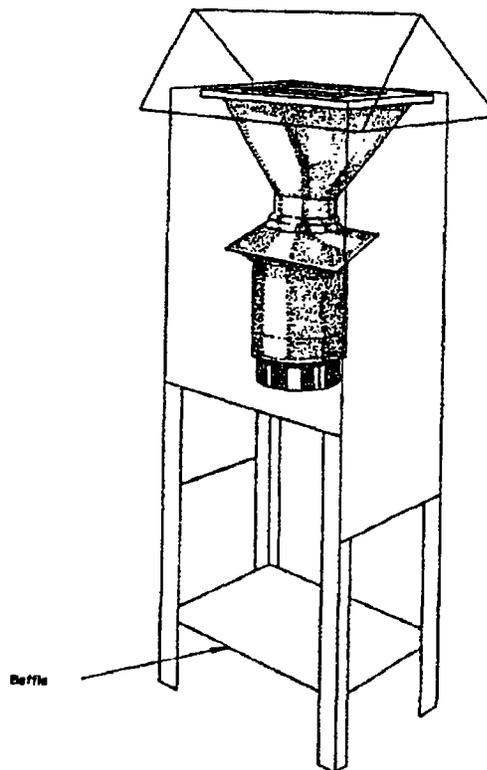


Figure 1. High-volume sampler in shelter.

EPA-600/4-77-027a
May 1977

**QUALITY ASSURANCE HANDBOOK
FOR
AIR POLLUTION MEASUREMENT SYSTEMS**

Volume II — Ambient Air Specific Methods

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Environmental Monitoring and Support Laboratory
Research Triangle Park, North Carolina 27711

6. Allow the system to operate for the 24-hour test period and determine the elapsed time from the elapsed time meter.

- a. If the elapsed time is 24 hours \pm 15 minutes, the timer is acceptable for field use.
- b. If the elapsed time is not 24 hours \pm 15 minutes, adjust the tripper switches and repeat the test.

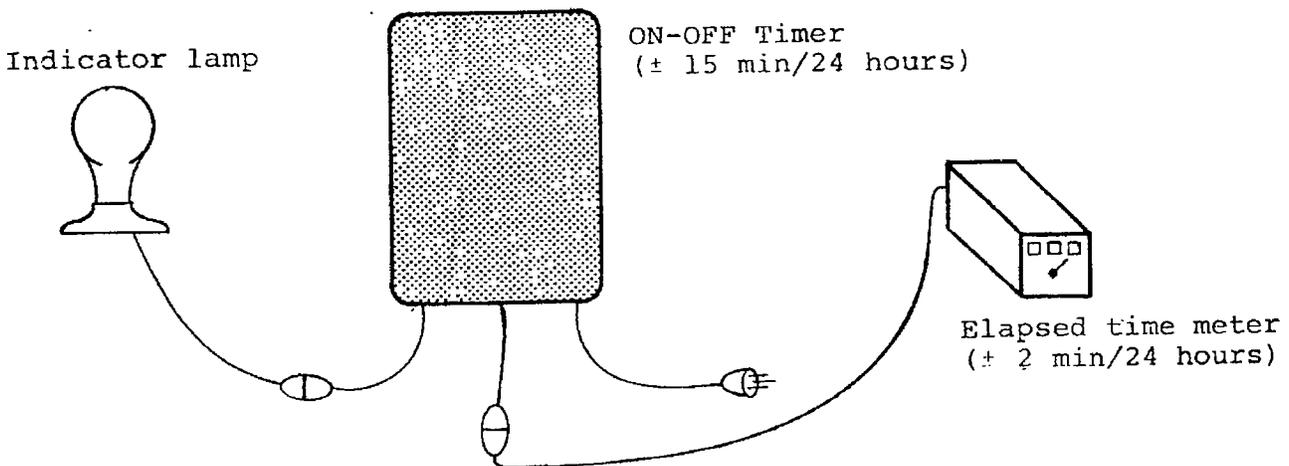


Figure 2.2 Diagram of a timer calibration system

2.5 Orifice Calibration Unit

The orifice calibration unit should be calibrated against a secondary standard, for example a Rootsmeter, upon receipt and at one-year intervals thereafter. The manufacturer's average calibration curve can be used unless the calibration deviates from it by more than \pm 4 percent at any one point along the curve. When deviations from the manufacturer's curve are larger than \pm 4 percent and there are no visible signs of damage to the orifice, the calibration should be repeated by another operator. If the large deviations persist (after the secondary standard has been checked