Deleted: 14

1.0 PURPOSE:

This procedure describes how to monitor the intakes of uranium in the bodies of workers at the Mill to keep radiation doses to levels that are As Low As Reasonably Achievable (ALARA).

2.0 APPLICABILITY

This procedure applies to:

2.1 Workers (1) routinely exposed to airborne yellowcake or directly involved in maintenance tasks in which yellowcake dust may be produced or (2) routinely exposed to airborne uranium ore dust.

2.2 Workers potentially exposed to a time-weighted exposure of 40 DAC hrs of natural uranium in a 40-hour work week.

2.3 Workers potentially exposed to a time-weighted average exposure of 3E-11 µCi/mL of ore dust for one calendar quarter.

2.4 Workers who must wear a respirator to maintain uranium inhalation exposures below the limits listed above and/or whenever it is suspected that a respirator has leaked or malfunctioned.

2.5 Whenever facial contamination is detected on a worker.

2.6 Whenever required by the Radiation Safety Officer (RSO) or his designee.

3.0 OTHER DOCUMENTS:

3.1 *REFERENCES:*

3.1.1 American National Standard – Bioassay Programs for Uranium, HPS N13.22-1995

3.1.2 Nuclear Regulatory Commission Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program"

3.1.3 Nuclear Regulatory Commission Regulatory Guide 8.22,"Bioassay at Uranium Mills"

3.1.4 Nuclear Regulatory Commission NUREG – 0874, Internal Dosimetry Model for Applications of Bioassay at Uranium Mills

3.1.5 Piñon Ridge Mill Emergency Response Plan

3.2 *APPENDICES:*

Appendix A – Uranium in Urine Report Form RH-050A

Appendix B – Bioassay Intake and Dose Estimates Form RH-050B

Appendix C – Table 1 Corrective Actions Based on Monthly Urinary Uranium Results

Appendix D – Table 2 Corrective Actions Based on In vivo Results

APPROVALS	*Signature*	*Date*
RSO		
Plant Manager		

Deleted: 14

4.0 EQUIPMENT AND MATERIALS

4.1 *MATERIALS*

4.1.1 Urine collection bottles

5.0 RESPONSIBILITY

5.1 The RSO is responsible for both the urinalysis and in-vivo counting bioassay programs, and for the calculation of intakes and radiation doses.

5.2 A Radiation/Security Technician (RST) is responsible for the collection of urine samples and the submission of the samples to the laboratory for analysis.

5.3 The individual radiation worker participating in the bioassay program is responsible for the submission of urine samples and participation in the in-vivo counting when requested.

6.0 PREREQUISITE INFORMATION

6.1 *FREQUENCY*

6.1.1 Urinalysis will be conducted weekly/monthly/quarterly, depending on worker exposures, product specific characteristics and other considerations at the discretion if the RSO.

6.1.2 In-vivo lung (thorax) counts will be conducted based on results and exceedence of action levels in urinalysis program.

6.1.3 Urinalysis may be conducted for emergency response personnel (both Mill and off-site) following an emergency response incident (see the Mill Emergency Response Plan) at the discretion of the RSO or Alternate RSO. Participation of non-Mill personnel is voluntary.

7.0 PROCEDURES

7.1 *URINALYSES*

7.1.1 Baseline uranium urinalyses are to be conducted on each worker in the urinalysis program prior to their initial work assignments and upon termination of employment.

7.1.2 Weekly uranium in urine bioassay samples are to be collected from workers where potential exposures exceed a time weighted average exposure of 5 E-10 µCi/mL of soluble uranium for 40 hours. A week is seven consecutive workdays or less. If the processing facility is operating on a 10-and-4 schedule, i.e., 10 days at work and 4 days off work, then the week is defined as 10 work days.

7.1.3 Monthly uranium in urine bioassays are to be performed on workers where exposures could exceed a time weighted average exposure of 2E-11 µCi/mL (total alpha) of insoluble uranium or uranium ore dust for one calendar quarter.

Deleted: 14

7.1.4 In addition to the above schedule, bioassays are to be performed on respirator users when the effectiveness of the respirator needs to be verified or when respirator failure or other problems that may have compromised the effectiveness of respirator are suspected.

7.1.5 All uranium in urine bioassay samples are to be collected at least 36 hours after the most recent potential exposure in the processing facility.

7.1.6 On the morning urine samples are to be submitted, each participant in the urinalysis program is to proceed to the change house to give the sample before changing into their work clothes. PARTICIPANTS MUST WASH THEIR HANDS BEFORE SUBMITTING THE SAMPLE. Provide at least a 30 mL sample in the sample bottle with a label printed with the participant's name. Write the time and date of sampling, the last time and date worked, and their initials on the label to verify that the sample was submitted as required. Immediately return the sample to the RST, who is to check that the label contains the required information.

7.1.7 The RST is to deliver the urine samples to the on-site laboratory with a chain of custody form (provided by the off-site laboratory).

7.1.8 The on-site laboratory will complete the required preservation, packing and chain of custody procedures and ship the sample to an off-site laboratory for analysis in accordance with the on-site and off-site laboratories' sample preparation procedures.

7.1.9 The RST and the Mill foremen are to coordinate to ensure the completion of the urine sampling as scheduled.

7.1.10 The measurement sensitivity for urine-analyses should be 5 µg of uranium per liter of urine or less.

7.1.11 Implement the corrective actions specified in Table 1 of the NRC Regulatory Guide 8.22 in response to the amount of uranium detected in the urine. That table is attached to this procedure in Form RH-050B.

7.1.12 Urinalysis results are to be available to the RSO or his designee within 7 days after sample collection. If an analysis exceeds 10 µg/L, the RSO is to be notified as soon as possible.

7.1.13 All laboratory analyses are to be performed in a laboratory that is essentially free of uranium contamination using contamination free equipment.

7.1.14 Each batch of specimens sent to the laboratory for analyses are to be accompanied by at least two control urine samples. Those control samples are to be taken from individuals who are not and have not been occupationally exposed to uranium; otherwise simulated controls known to contain uranium concentrations less than 1 µg/L may be used. Aliquots of each of these control urine samples should be taken; one should be a "blank," one should be spiked with uranium to obtain a concentration of 10-20 µg/L, and one should be spiked to 40-60 µg/L; the actual spike

Deleted: 14

concentration being recorded confidentially and not available to the laboratory technicians. When results are received, the RSO or his designee should ensure that each reading is corrected for the reading of the corresponding blank, that the average of the percent deviation of the spiked sample net reported values from the "true" amount of spiked uranium sample is calculated. The percent deviation from the spiked samples accompanying each batch of urine samples should be within 30% of the spiked values. Likewise, the percentage deviation of the blank sample from the normal background count of the blank samples should be within 30% of the blank sample. If the spike or blank sample is not within the 30%, the most recent batch of affected samples will be rerun. Steps should be taken to correct the procedures for spiking, the procedures for laboratory analyses, procedures for contamination control, or a combination of those procedures. The laboratory is to duplicate the analyses of 10-20% of the samples received, including the blanks and spikes. The results of the laboratory blanks and standard samples are to be available to the RSO or his designee.

7.1.15 Record the results of the urinalyses for all analyses greater than 10 µg/L on Form RH-050A or the equivalent. The form is to be routed to the personnel designated on the form within 4 days. Corrective actions and responses are to be specified on the form. Complete all portions of the form.

7.2 ***IN-VIVO LUNG (THORAX)***

7.2.1 When urinalysis results are confirmed to be greater than 35 µg/L for two consecutive specimens, or are confirmed to be greater than 130 µg/L for any single specimen, or air sampling indicates more than a quarterly limit of intake to relatively insoluble uranium, perform in-vivo counting a quickly as possible to determine if corrective actions are required.

7.2.2 When in-vivo measurements are to be conducted, they should be performed as quickly as possible, but no later than 3 months after such indications.

7.2.3 The lung counting procedure is to be capable of detecting 9 nCi or less of uranium.

7.2.4 Implement the corrective actions specified in Table 2 of the NRC Regulatory Guide 8.22 (see Appendix D) in response to the amount of uranium detected in the lungs of workers.

7.3 ***DECISION ANALYSIS FOR URINALYSES***

7.3.1 When an individual urine bioassay result indicates a potential uranium concentration greater than 15 µg per liter, the RSO is to initiate an investigation. The investigation will consist of the following steps:

7.3.1.1 Immediate resample providing additional exposures have not occurred

Deleted: 14

7.3.1.2 Interview with the employee

7.3.1.3 Review the air sampling data for the period covered by the urine sample

7.3.1.4 Review of the employee's work record to determine if and when the assumed intake might have occurred.

7.3.2 Elevated urine bioassay uranium concentrations can result from several conditions:

7.3.2.1 Inhalation intake of uranium in airborne particulate matter

7.3.2.2 Ingestion intake of uranium

7.3.2.3 Contamination of sample during collection

7.3.2.4 Laboratory error

7.3.3 If the investigation indicates that the elevated urine bioassay measurement may represent a confirmed intake, the RSO is to calculate the potential intake of uranium by the worker according to the attached Form RH-050B or the equivalent.

7.3.4 If the analysis indicates that the intake is less than 10 mg of soluble uranium, a report is placed in the file.

7.3.5 If the calculated intake is greater than 10 mg of soluble uranium, CDPHE IS TO BE NOTIFIED of the noncompliance with the 10 mg/week limit for soluble uranium as specified in the Colorado Department of Public Health and Environment Radiation Control Division regulations (6 CCR 1007-1 4.6.5).

Uranium Bioassay Procedure RH-050

Appendix A

Uranium in Urine Report Form RH-050A

Uranium In Urine Report Form RH-050A

Analytical results of >10 µg/l u must be reported on this form immediately*

SAMPLE SUB. FORM NO.	EMPLOYEE NAME	EMPLOYEE NUMBER	ORIGINAL RESULT	RERUN RESULT	SAMPLE DATE
			µg/L U	µg/L U	

ACKNOWLEDGEMENT OF SAMPLE ANALYSIS (initial and date) [all <4 days**]

Mill Manager (1 day**)	RSO (1 day**)	General Foreman (1 day**)	RST	Other

SAMPLE INFORMATION

Was sample taken more than 36 hours after last work on site? Original: [ ] yes [ ] no Follow-up:[ ] yes [ ] no

Previous sampling: [< 2 weeks**] sample date: analytical date: result: µg/L

Follow-up sampling: [< 2 weeks**] sample date: analytical date: result: µg/L

Was employee notified? [< 5 days**] [ ] yes [ ] no | Date: | By (initials):

Where did employee work? [< 5 days**] (circle suspect areas)

Was respiratory protection used? [ ] yes [ ] no | Type: | Duration:

Other information:

RESPONSES AND ACTIONS PLANNED OR TAKEN (***) (continue on back if necessary)

[ ] continued on back

Final determination on potential exposure: [<21 days**] [ ] exposure confirmed [ ] contaminated sample

Justification for final determination:

Final recommendations:

ACKNOWLEDGEMENT OF FINAL DETERMINATION AND RECOMMENDATIONS (initial and date) [<30 days**]

Employee	Mill Manager	RSO	Gen. Foreman	RST	Other

Completed form added to employee's permanent file? [<45 days**] [ ] yes [ ] no

*Notes: * - Analyst must fill in sample data and results, initial, date and give the form to the Lab Manager.*
*** - target time to complete item following analysis of original sample.*
**** - see back of form for corrective action requirements.*

Uranium Bioassay Procedure RH-050

Appendix B

Bioassay Intake and Dose Estimates Form RH-050B

Bioassay Intake and Dose Estimates

The following procedure will be used to estimate the potential dose to a worker based on a urine bioassay concentration greater than 10 µg/L.

Employee Number_____

Table 1: Concentration of uranium in urine

Sample No.	Uranium concentration in urine (µg/L)	Sample Date	Days since previous sample less than 15 µg/L	Solubility class
1				
2				
3				
4				
5				

Table 2: **Uranium excretion functions** - fraction of intake by inhalation excreted in 24 hours (from *Bioassay Programs for Uranium*. HPS N13.22-1995)

Days since exposure	Retention Function (Class D)	Retention Function (Class W)	Retention Function (Class Y)
1	1.87E-01	4.13E-02	2.23E-03
2	7.27E-02	1.09E-02	5.49E-04
3	3.21E-02	4.72E-03	2.30E-04
4	1.82E-02	3.22E-03	1.57E-04
5	1.31E-02	2.69E-03	1.31E-04
6	1.09E-02	2.40E-03	1.17E-04
7	9.64E-03	2.19E-03	1.07E-04
8	8.71E-03	2.02E-03	9.81E-05
9	7.94E-03	1.88E-03	9.07E-05
10	7.26E-03	1.75E-03	8.42E-05
11	6.86E-03*	1.68E-03	8.04E-05
12	6.46E-03	1.61E-03	7.67E-05
13	6.06E-03	1.54E-03	7.30E-05
14	5.66E-03	1.47E-03	6.93E-05
15	5.26E-03	1.39E-03	6.56E-05
16	4.86E-03	1.32E-03	6.19E-05
17	4.46E-03	1.25E-03	5.82E-05
18	4.06E-03	1.18E-03	5.45E-05
19	3.66E-03	1.11E-03	5.07E-05
20	3.26E-03	1.03E-03	4.69E-05

*Excretion fractions for 11 to 20 days post intake are interpolated values.

Estimated intake = [U conc. in urine in µg/L][1.4 L/d][0.68 pCi/µg]/[F (d)]

Where F(d) = fraction of the initial intake excreted in urine per day at d days after an acute intake.

Uranium Bioassay Procedure RH-050

Appendix C

Table 1 Corrective Actions Based on Monthly Urinary Uranium Results

Table 1
Corrective Actions Based on Monthly Urinary Uranium Results [a]

Urinary Uranium Concentration	Interpretation	Actions
Less than 15 µg/L	Uranium confinement sampling programs are indicated to be adequate.[b]	None - Continue to review further bioassay results.
15 to 35 µg/L	Uranium confinement and air sampling may not provide an adequate margin of safety.[b]	1. Confirm results (repeat urinalysis). 2. Identify the cause of elevated urinary uranium and initiate additional control measure if the result is confirmed. 3. Examine air sampling data to determine the source and concentration of intake. If air sampling results are anomalous, investigate sampling procedures. Make corrections if necessary. 4. Determine whether other workers could have been exposed and perform bioassay measurements for them. 5. Consider work assignment limitations until the worker's urinary uranium concentration falls below 15 µg/L. 6. Improve uranium confinement controls or respiratory protection program as investigation indicates.
Greater than 35 µg/L	Uranium confinement and perhaps air sampling programs are not acceptable.[c]	1. Take the actions given above. 2. Continue operations only if it is virtually certain that no other worker will exceed a urinary uranium concentration of 35 µg/L. 3. Establish work restrictions for affected employees or increase uranium confinement controls if ore dust or high-temperature dried yellowcake are involved. 4. Analyze bioassay samples weekly.
Confirmed to be greater than 35 µg/L for two consecutive specimens, confirmed to be Greater than 130 µg/L for any single specimen, or air sampling indication of more than a quarterly Limit on Intake.	Worker may have exceeded regulatory limit on intake.	1. Take the actions given above. 2. Have urine specimen tested for albuminuria. 3. Obtain an in vivo count if worker may have been exposed to Class Y material or ore dust. 4. Evaluate exposures. 5. Establish further uranium confinement controls or respiratory protection requirements as indicated. 6. Consider continued work restrictions on affected Employees until urinary concentrations are below 15 µg/L and laboratory test for albuminuria are negative.

[a] Use Figures 1-3 to adjust action levels for other frequencies of bioassay sampling. The model used in NUREG-0874 (Ref.1) employs fractional composition values (F1, F_2, F_3) for Class D, Class W, and Class Y components of yellowcake compounds. The assigned values in NUREG-0874 are based on data from available literature. The use of alternative values of F1, F_2, F_3 specific for a particular operation are acceptable provided (1) details regarding their determination are described and mentioned in employee exposure records (use paragraph 20.401(e) (1) of 10 CFR Part 20) and (2) the model as published in NUREG-0874 is then used in the determination of alternative urinalysis frequencies and action levels.

[b] However, if a person is exposed to uranium ore dust or other material of Class W or Y alone, refer to Section 6 of NURGEG-0474 about the possibility of the need for conducting in vivo lung counts on selected personnel or about using alternative urine sampling times and associated action levels computed using NUREG-0874.

[c] Unless the result was anticipated and caused by conditions already corrected.

Uranium Bioassay Procedure RH-050

Appendix D

Table 2 Corrective Actions Based on In-Vivo Results

Table 2
Corrective Actions Based on In-Vivo Results [a]

Amount of Uranium Detected	Interpretation	Actions
Below 9 nCi (330 Bq)	May be below detection limit. This result does not necessarily indicate that uranium confinement and air sampling programs are validated.	Rely on urinalysis results to determine corrective actions (unless air sampling indicates quarterly intake limits are exceeded for ore dust).
9 to 16 nCi (330 to 590 Bq)	Confinement and air sampling programs should be examined.[b] Uranium activity in lungs could be too high.	1. Confirm result (repeat measurement within 6 months). Ensure that results are not caused by body surface activity. 2. Examine air sampling data to determine source and concentrations of intake. If air sampling results are anomalous, investigate air sampling procedures. Make corrections, if necessary. 3. Identify the cause of elevated activity and initiate additional uranium confinement control measures. 4. Determine whether other workers could have been exposed and perform special bioassay measurements for them. 5. Consider work assignment limitations that will permit the lung burden to be reduced through natural elimination; ensure that the lung burden does not exceed 16 nCi (590 Bq).
More than 16 nCi (590 Bq)	Uranium confinement and air sampling probably are not acceptable.[b] Uranium activity in the lungs should be reduced by increased protection measures for the workers involved.	1. Within 90 days, take the actions listed above for 9 to 16 nCi (330 to 590 Bq). 2. Establish work restrictions for workers or increased uranium confinement control measures. (Normally workers with a lung burden greater than 16 nCi (590Bq) are not allowed by their employee to resume work in airborne activity areas until the burden is reduced to less than 9 nCi (330Bq). 3. Perform individual case studies (bioassays) for affected workers. 4. Continue operations only when it is virtually certain no additional workers will exceed16 nCi (590 Bq).

[a] The model used in NUREG-0874 (Ref.1) employs fractional composition values (F1, F_2, F_3) for Class D, Class W, and Class Y components of yellowcake compounds. The assigned values in NUREG-0874 are based on data from available literature. The use of alternative values of F1, F_2, F_3 specific for a particular operation are acceptable provided (1) details regarding their determination are described and mentioned in employee exposure records (use paragraph 20.401(e) (1) of 10 CFR Part 20) and (2) the model as published in NUREG-0874 is then used in the determination of alternative urinalysis frequencies and action levels.

[b] Unless the result was anticipated and caused by conditions already corrected.

Deleted: 14

1.0 PURPOSE

This procedure describes how to conduct a beta and/or a gamma survey within the Mill. The purpose of the survey is to identify areas of elevated beta or gamma exposures so that the radiation doses may be kept to levels that are As Low As Reasonably Achievable (ALARA). Gamma monitoring of personnel using dosimeters is addressed in the Personal Radiation Dosimeters Procedure RH-210.

2.0 APPLICABILITY

This procedure provides guidance to the radiation protection staff or others conducting beta and/or gamma exposure rate surveys of the facilities. All personnel and visitors present inside the uranium processing facility are to maintain their radiation doses at levels that are ALARA.

3.0 OTHER DOCUMENTS

3.1 *REFERENCES*

3.1.1 NRC Regulatory Guide 8.30, "Health Physics Surveys in Uranium Mills."

3.1.2 Posting Procedure RH-030

3.1.3 Piñon Ridge Mill Emergency Response Plan

3.1.4 Colorado Rules and Regulations Pertaining to Radiation Control, Part 4 (6 CCR 1007-1).

3.2 *APPENDICES*

Appendix A – Correction Factor for Beta Survey Instruments

Appendix B – Beta/Gamma Survey Form RH-110A

4.0 EQUIPMENT AND MATERIALS

4.1 *EQUIPMENT*

4.1.1 Ludlum model 2241 series scaler/ratemeter or equivalent

4.1.2 Ludlum model 2929 alpha/beta sample counter or equivalent

4.1.3 Ludlum 44-9 pancake GM probe or equivalent

4.1.4 Ludlum model 12s micro R meter or equivalent

4.1.5 Ludlum model 44 -10 gamma scintillation probe, 2 x 2 or equivalent

4.1.6 NIST beta and gamma check sources for determining instrument and detector efficiencies.

5.0 RESPONSIBILITY

5.1 The Radiation Safety Officer (RSO) or the Alternate RSO is responsible for:

5.1.1 Reviewing Form RH-110A for accuracy and completeness

5.1.2 Evaluating any trends of increasing or decreasing exposures rates over time.

APPROVALS	*Signature*	*Date*
RSO		
Plant Manager		

Deleted: 14

5.1.3 Instituting ALARA reviews and/or corrective actions in response to undesirable trends involving measured exposure rates

5.2 The Radiation/Security Technician (RST) is responsible for:

5.2.1 Conducting gamma surveys at representative work locations.

5.2.2 Performing beta exposure surveys of areas or equipment at the Mill.

5.3 The Quality Assurance Officer or designee is responsible for:

5.3.1 Assuring that personnel considered as key individuals relevant to this procedure are documented as properly trained and/or qualified to perform the required duties.

5.3.2 Assuring that the quality principles of this procedure are followed and maintained.

6.0 PREREQUISITE INFORMATION

6.1 *DEFINITIONS*

Radiation Area – An area accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

6.2 *SAFETY*

Beta calibration of instruments using yellowcake or other processing material samples subject to dusting will be performed under a dust collection hood.

6.3 *FREQUENCY*

6.3.1 Monthly gamma radiation surveys in Radiation Areas and where specified by the RSO.

6.3.2 Quarterly gamma and beta-gamma radiation surveys in other plant areas as determined by the RSO.

6.3.3 Pre and post-job surveys shall be completed as needed to verify changing radiological work conditions, as indicated in radiation work permits, and at the discretion of the RSO or Alternate RSO.

6.3.4 Surveys may be conducted during or following an emergency incident (see the Mill Emergency Response Plan) at the discretion of the RSO or Alternate RSO.

7.0 PROCEDURES

7.1 *GAMMA SURVEYS*

7.1.1 The RST is to turn on the gamma survey meter. Use the battery scale on the meter to check the condition of the batteries. Change the batteries if low battery voltage is indicated.

7.1.2 Read the calibration sticker on the instrument to verify that the instrument has been calibrated within the last year or as specified by the

Deleted: 14

manufacturer. If not, use an instrument that is in calibration. Record the instrument and probe serial numbers on Form RH-110A or the equivalent.

7.1.3 Inspect the survey meter, probe and probe cable for damage etc. If damaged, replace cable etc. or select another instrument for the survey.

7.1.4 Note the instrument reading without the check source present and record on calibration check form. This is the background count rate.

7.1.5 Place the gamma check source on contact with the instrument detector and observe the reading, subtract the background measurement and record the net reading on Form RH-110A. Use the same check source that was used to determine the reference reading when the instrument was calibrated. If the reading with the check source varies more than 20% (Reg. Guide 8.30, page 21) from the historic reference readings, select another instrument for the survey and submit the defective instrument for repair.

7.1.6 The RST is to survey at least 20 locations quarterly to characterize exposures rates to workers in the facility. Included shall be areas where workers might stand or work or approximately 12 inches from the equipment. Record the results on Form RH-110A.

7.1.7 If the dose rate in areas accessible to workers exceeds 5 mrem/hr at 12 inches from the radiation source, post the area as a "Radiation Area" in accordance with the Posting Procedure RH-030 and resurvey quarterly.

7.2 *BETA-GAMMA EXPOSURE RATE SURVEY OF EQUIPMENT AND MATERIALS*

7.2.1 Turn on the instrument equipped with a GM pancake probe or GM probe with a sliding shield. Use battery scale on the meter to check the condition of the batteries. Change the batteries if low battery voltage is indicated.

7.2.2 Read the calibration sticker on the instrument to verify that the instrument has been calibrated within the last year or at a frequency specified by the manufacturer. If not, use an instrument that has a current calibration. Record the instrument serial number on Form RH-110A or the equivalent.

7.2.3 Inspect the meter and probe for damage. If damaged, use another instrument.

7.2.4 Observe the instrument background count rate and record on the calibration form.

7.2.5 Measure the beta check source activity. Proceed if the measured activity is within 20% of the historic reference readings. Record the check source activity on Form RH-110A or the equivalent.

7.2.6 Quarterly beta radiation surveys are to be performed at representative locations where workers are exposed, when equipment or operating procedures are modified in a way that may have changed the beta dose that would be received by the worker, and specifically at locations that involve direct handling of large quantities of aged yellowcake. Additional surveys will be performed at locations where other materials for processing are stored and processed to evaluate the exposure levels.

Deleted: 14

7.2.7 Perform a measurement with the pancake probe without a probe shield and subtract the background reading. This net reading is the beta + gamma exposure rate.

7.2.8 Perform a measurement using the pancake probe with the plastic shield in place. Subtract the background reading recorded in 7.2.4 above. This net reading is the gamma only exposure rate from the item surface.

7.2.9 Determine the difference between the two measurements and multiply the reading by the beta correction factor. See Appendix A for the determination of the beta correction factor. The correction factor is noted on a label attached to the instrument.

7.2.10 Determine the beta-gamma exposure rate by summing the gamma only measurement as determined in 7.2.8 and the corrected beta reading calculated in 7.2.9. Record the average and maximum beta-gamma exposure rates on Form RH-110A.

7.2.11 Update area postings and Radiological Work Permit (RWP) information, as necessary.

7.2.12 Post a copy of the radiological survey in Radiation Areas to allow personnel to review conditions.

7.2.13 Notify the RSO or Alternate RSO of any significant changes in radiological conditions.

7.3 ***DOCUMENTATION***

7.3.1 The RSO or Alternate RSO shall review and sign the Form RH-110A or equivalent.

7.3.2 The Alternate RSO or designee shall file Form RH-110A or equivalent in the Safety Department Records.

7.3.3 Retain Form RH-110A or equivalent for 3 years.

Beta and/or Gamma Exposure Rate Surveys Procedure RH-110

Appendix A

Correction Factors

Correction Factor for Beta Survey Instruments

As noted in the USNRC Regulatory Guide 8.30, "Health Physics Surveys of Uranium Mills," Appendix C, a correction factor needs to be generated for the beta survey instrument. The beta survey correction factor is calculated as follows:

$$CF = \frac{YC}{R_u - R_s}$$

Where:

CF = Correction factor

YC = Actual beta dose rate from an old yellowcake source

= 75 mrem/hr at 2 cm from the surface or 150 mrem/hr at the surface (Reg. Guide 8.30, Appendix C)

R_u = Unshielded exposure rate

R_s = Shielded exposure rate

Correction Factor for Probes with a Sliding Shield

For survey instruments with a GM probe and a sliding shield the beta survey correction factor was calculated as shown in the following example:

Instruments:

Eberline Model E 140 Survey Meter with an HP 270 GM probe with a sliding shield, Serial # 1760, calibrated 2-02-02. Eberline Model E 140 Survey Meter with an HP 270 GM probe with a sliding shield, Serial # 2263, calibrated 2-02-02.

Source: "Black yellowcake, 9-25-85, Lot 8406-60, Uncovered lab sample from drum. Data courtesy of Cotter Corporation.

Measurements at 2 cm from source on 7/17/02:	Meter # 1760	Meter # 2263
• Background	0.04 mR/hr	0.04 mR/hr
• Probe shield closed	10. mR/hr	12. mR/hr
• Probe shield open	40. mR/hr	36. mR/hr

CF at 2 cm for instrument # 1760 $= \frac{YC}{R_u - R_s} = \frac{75}{40-10} = 2.5$

CF at 2 cm for instrument # 1760 $= \frac{YC}{R_u - R_s} = \frac{75}{36-12} = 3.1$

Different correction factors may be determined when processing high thorium content ores.

Correction Factor for a Pancake Probe

For survey instruments with a pancake probe, a beta survey correction factor can be calculated as follows:

Instruments: Eberline E-140 with a HP-210 probe or the equivalent.

Material Source:

Processing material sample e.g. Black aged yellowcake, Uncovered lab sample from drum.

Measurements:

Take two measurements with the meter:

- At 2 cm above the surface of the yellowcake or other processing material <u>without the plastic detector shield</u>,
- At 2 cm above the surface of the yellowcake or other processing material <u>with the plastic detector shield in place.</u>

A 1.0 cm thick Plexiglas or Lucite plate may be used for the plastic detector shield.

Calculate the correction factor as shown above.

Application of the Correction Factor

The actual beta dose rate = $(S_u - S_s)(CF)$

Where:

S_u = Unshielded exposure rate from a source such as a contaminated tool.

S_s = Shielded exposure rate from a source such as a contaminated tool. The shield can be a sliding shield on a GM detector or a piece of 1.0 cm thick Plexiglas used with a pancake probe.

Beta-gamma dose rate = Actual beta dose rate + Gamma (shielded) dose rate

Beta and/or Gamma Exposure Rate Surveys Procedure RH-110

Appendix B

Beta/Gamma Survey Form RH-110A

Beta/Gamma Survey Form

Instrument _____ SN _____

Detector/Probe _____ SN _____ Calibration Date _____

Net Check Source Reading _____ Historical check source reading _____

Date	Survey Location[1]	Type of Measurement	Gamma plus Beta Reading	Gamma Only Reading

1) Complete a diagram of the radiological area boundaries on the following sheet.

Survey Completed by (Print Name) _____

Employee Number _____

Signature _____ Date _____

Survey Reviewed by (Print Name) _____

Employee Number _____

Signature _____ Date _____

Diagram of the Radiological Area Boundaries

Deleted: 13

1.0 PURPOSE

This procedure describes methods for measuring alpha and beta-gamma surface contamination.

2.0 APPLICABILITY

This procedure applies to all equipment, materials and personnel potentially contaminated in and around the Piñon Ridge Mill.

3.0 OTHER DOCUMENTS

3.1 *REFERENCES*

3.1.1 NRC Regulatory Guide 8.30, Health Physics Surveys in Uranium Recovery Facilities.

3.1.2 NUREG 1507 "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminates and Field Conditions."

3.1.3 Colorado Rules and Regulations Pertaining to Radiation Control, Part 4 (6 CCR 1007-1).

Deleted: Regulations

3.1.4 Decontamination Procedure RH-020.

3.1.5 Radiation Exposure Action Levels Procedure RH-040

3.1.6 Radiation Work Permits Procedure RH-060

3.1.7 Release of Equipment to Unrestricted Areas Procedure RH-070

3.1.8 Personnel Release Surveys Procedure RH-200

3.1.9 Piñon Ridge Mill Facility Operating Plan

3.1.10 Piñon Ridge Mill Emergency Response Plan

3.2 *APPENDICES*

Appendix A – Alpha/Beta-Gamma Contamination Survey Report Form RH-120A.

4.0 EQUIPMENT AND MATERIALS

4.1 *EQUIPMENT*

4.1.1 Ludlum model 43 series alpha detectors (scintillation, proportional or phoswich) or equivalent

4.1.2 Ludlum model 2241 series scaler/ratemeter or equivalent

4.1.3 Ludlum model 2929 alpha/beta-gamma sample counter or equivalent

4.1.4 Ludlum 44-9 pancake GM probe or equivalent

4.1.5 Ludlum model 12s micro R meter or equivalent

4.1.6 Ludlum model 44 -10 gamma scintillation probe, 2 x 2 or equivalent

4.1.7 Protective gloves

APPROVALS	*Signature*	*Date*
RSO		
Plant Manager		

Deleted: 13

4.1.8 Swipes

4.1.9 Form RH-120A or the equivalent.

4.1.10 Th-230 National Institute of Standards and Technology (NIST)-traceable alpha check source or equivalent

4.1.11 NIST beta-gamma check sources for determining instrument and detector efficiencies

5.0 RESPONSIBILITY

5.1 The Radiation Safety Officer (RSO) or Alternate RSO is responsible for:

5.1.1 Assuring that all personnel performing the surveys are properly trained.

5.1.2 Determining the locations throughout the facility where surveys should be performed.

5.1.3 Determining the frequency of sampling at a given location based on previous scans or by administrative controls.

5.1.4 Determining any corrective actions that should be put into affect to alleviate areas of higher radioactivity in the Mill.

5.1.5 Reviewing Contamination Survey Reports.

5.1.6 Reporting any undesirable trends to management as soon as practical and documenting program trends in the annual report.

5.2 The Radiation/Security Technician (RST) is responsible for:

5.2.1 Assuring that data are collected according to this procedure.

5.2.2 Filing and retaining the Alpha/Beta-Gamma Contamination Survey Report Form RH-120A or the equivalent.

5.3 The Quality Assurance Officer or designee is responsible for:

5.3.1 Assuring that personnel considered as key individuals relevant to this procedure are documented as properly trained and/or qualified to perform the required duties.

5.3.2 Assuring that the quality principles of this procedure are followed and maintained.

6.0 PREREQUISITE INFORMATION

6.1 *FREQUENCY*

6.1.1 Alpha and beta-gamma contamination area surveys for total and removable contamination will be conducted weekly throughout restricted, unrestricted and clean areas of the Mill facility as specified by license conditions and/or the RSO or Alternate RSO.

6.1.2 Alpha and beta-gamma contamination equipment and materials surveys will be conducted when equipment or materials need to be removed from the restricted area for unrestricted use or repair in accordance with the Release of Equipment to Unrestricted Areas Procedure RH-070.

6.1.3 Alpha and beta-gamma contamination personnel surveys will be conducted when personnel are leaving the restricted area, leaving an area of higher contamination potential or entering a clean area in accordance

Deleted: 13

with the Personnel Release Surveys Procedure RH-200.

6.1.4 Pre and post job surveys will be conducted as needed in support of work activities and Radiological Work Permits (RWPs) to verify changing radiological conditions, or at the direction of the RSO or Alternate RSO.

6.1.5 Surveys may be conducted during or following an emergency incident (see the Mill Emergency Response Plan) at the discretion of the RSO or Alternate RSO.

7.0 PROCEDURES

7.1 *INSTRUMENT INSPECTION*

7.1.1 When performing contamination surveys, the surveyor is to wear protective gloves.

7.1.2 The surveyor will check the operation of the instrument(s) selected for monitoring. Refer to the instrument's operational manual for specific information.

7.1.2.1 Turn on the survey meter.

7.1.2.2 Use the battery scale on the meter to check the condition of the batteries. Change the batteries if low battery voltage is indicated.

7.1.2.3 For line-powered instruments, verify that the power cord is plugged in and that there is power to the outlet.

7.1.2.4 Read the calibration sticker on the instrument to verify that the instrument has been calibrated within the last year or at a frequency specified by the manufacturer. If not, use an instrument that has a current calibration. Record the instrument serial number on Form RH-120A or equivalent.

7.1.3 Inspect the survey meter for damage.

7.1.3.1 If an alpha scintillation probe is to be used in the survey, hold the probe towards a light source. If the count rate suddenly increases, look for tiny pinholes in the Mylar surface of the probe face. Repairs can be made with "whiteout." If two or more whiteout spots are present, use another instrument and report the damage to the RSO or Alternate RSO.

7.1.3.2 RSO or Alternate RSO will replace damaged instrument with properly working instrument.

7.1.3.3 RSO or Alternate RSO will tag instrument with RST name, date, and problem.

7.1.3.4 RSO or Alternate RSO will take damaged instrument to the Safety Department for evaluation, repair and/or replacement.

7.2 *ALPHA SURVEY INSTRUMENT CHECKS*

7.2.1 Perform the Instrument Inspection sup-procedure outlined in Section 7.1, above.

7.2.2 Observe the background count rate of the instrument and record the background rate observed on the instrument(s) on Form RH-120A.

Deleted: 13

7.2.2.1 Preferably, perform surveys in a low background area.

7.2.2.2 If more than five counts per minute alpha, use a different survey meter and report the potential contamination and/or malfunction to the RSO or Alternate RSO.

7.2.2.3 For a laboratory-type counting instrument, the background rate should be less than 5 cpm alpha. If not, decontaminate the counting chamber using an alcohol wipe, or the equivalent, and recount the background.

7.2.3 Position the probe face of the survey meter within 1.0 cm of the Th-230 or the equivalent alpha check source. Use the end of one's finger or jig under the edge of the alpha probe as a guide for the 1.0 cm spacing. Use a source-to-detector distance for the calibration that is similar to the expected surface-to-detector spacing used in the field. Record the reading on Form RH-120A or equivalent. If the reading is within 20% (Reg. Guide 8.30, page 21) of the historic reference readings, conclude that the instrument is functioning properly. If not, report the malfunction to the RSO or Alternate RSO and use an instrument that is functioning properly.

7.2.4 Calculate the portable survey instrument correction factor by:

$$\text{Alpha Correction factor} = \frac{(\text{Source dpm})\,(100\ \text{cm}^2)\,(E_s)}{(\text{Meter cpm})\,(X\ \text{cm}^2)}$$

Where X is the detection surface area of the probe with no corrections made for the protective screen and 100 cm^2 is the area specified in the release limits. The "source dpm/meter cpm" measurement corrects for the screen covering part of the detection area of the probe. E_s = Efficiency of the instrument.

7.2.5 Determine the instrument minimum detectable activity (MDA) and record on the calibration form.

7.2.5.1 For an integrated measurement over a preset time, the MDA can be approximated by:

$$\text{MDA} = \frac{2.71 + 4.65\sqrt{[(B_R)(t)]}}{(t)(E)(A/100)}$$

7.2.5.2 For a ratemeter instrument the MDA can be approximated by taking twice the time constant of the meter as the counting time:

$$\text{MDA} = \frac{4.65\sqrt{[(B_R)/(2t_c)]}}{(E)(A/100)}$$

Where:

MDA = minimal detectable activity in dpm/100 cm^2

B_R = background cpm

t = counting time in minutes

t_c = meter time constant in minutes

E = instrument detector efficiency

A = probe area in cm^2

Deleted: 13

7.2.5.3 For a laboratory-type instrument the MDA can be approximated by:

$$MDA = \frac{2.71 + 3.45\sqrt{[(B_R)(t)]}}{(t)(E)}$$

7.3 ***BETA-GAMMA SURVEY INSTRUMENT CHECKS***

7.3.1 Perform the Instrument Inspection sup-procedure outlined in Section 7.1, above.

7.3.2 Observe the background count rate of the instrument and record the background rate observed on the instrument(s) on Form RH-120A or equivalent.

7.3.2.1 Preferably, perform surveys in a low background area.

7.3.2.2 For a laboratory-type counting instrument, the background rate should be less than 100 cpm. If not, decontaminate the counting chamber using an alcohol wipe, or the equivalent, and recount the background.

7.3.3 Using a Cl-36 calibration standard for beta and a Cs-137 calibration standard for gamma or the equivalent and a source-to-detector distance for the calibration that is similar to the expected surface-to-detector spacing used in the field (e.g. 1 cm) measure the source activity and background with a pancake probe. Proceed if the measured activity is within 20% of the historic calibration measurements. If not, report to the RSO or Alternate RSO and use an instrument that is functioning properly.

7.3.4 Calculate the pancake probe beta-gamma correction factor by:

$$\text{Pancake Beta-Gamma Correction factor} = \frac{(\text{Source dpm})\,(100\ cm^2)(E_s)}{(\text{Meter cpm})\,(X\ cm^2)}$$

Where X is the pancake probe detection surface area and 100 cm^2 is the surface area specified in the release limits. The "source dpm/meter cpm" measurement corrects for the screen covering part of the detection area of the probe.

7.3.5 Calculate the efficiency of the pancake probe as:

$$E = \frac{\text{meter cpm} - \text{background cpm}}{\text{Source dpm}}$$

7.3.6 Determine the pancake instrument minimum detectable activity (MDA) using E calculated above.

7.3.6.1 For an integrated measurement over a preset time, the MDA can be approximated by:

$$MDA = \frac{2.71 + 4.65\sqrt{[(B_R)(t)]}}{(t)(E)(A/100)}$$

7.3.6.2 For a ratemeter instrument, the MDA can be approximated by taking twice the time constant of the meter as the counting time:

$$MDA = \frac{4.65\sqrt{[(B_R)/(2t_c)]}}{(E)(A/100)}$$

Deleted: 13

Where:

MDA = minimal detectable activity in dpm/100 cm^2

B_R = background cpm

t = counting time in minutes

t_c = meter time constant in minutes

E = instrument detector efficiency

A = probe area in cm^2

7.3.6.3 For a laboratory-type instrument, the MDA can be approximated by:

$$MDA = \frac{2.71 + 3.45 \sqrt{[(B_R)(t)]}}{(t)(E)}$$

7.4 ***TOTAL ALPHA CONTAMINATION SURVEY***

7.4.1 Perform Alpha Survey Instrument Check sub-procedure outlined in section 7.2, above.

7.4.2 If the item to be monitored is wet, dry the item prior to conducting the alpha survey.

7.4.3 Survey the surface.

7.4.3.1 Position the probe face of the survey meter within 1.0 cm of the equipment or material being monitored.

7.4.3.2 Minimize touching the probe face with the surface being surveyed to avoid the possibility of contaminating the probe face.

7.4.3.3 Use the end of one's finger or jig under the edge of the alpha probe as a guide to the 1.0 cm spacing.

7.4.3.4 Slowly (~1 cm/sec) move the probe over the area to be surveyed stopping at areas of suspect contamination to obtain an accurate determination of the level of contamination. Average surface contamination measurements are for 100 cm^2 areas averaged over 1 m^2. Note increases in the count rates as indicated by the instrument's audible output.

7.4.3.5 Maximum contamination measurements are averaged over 100 cm^2. Survey several different areas to obtain an average count rate and a maximum count rate.

7.4.4 Subtract the background cpm reading observed during the survey. Multiply the highest and average survey result by the correction factor and record on Form RH-120A or equivalent under the Total Alpha dpm/100 cm^2 column.

7.5 ***REMOVABLE ALPHA CONTAMINATION SURVEY***

7.5.1 Measure for removable alpha activity only if the Total Alpha Activity exceeds the appropriate removable activity release limit.

7.5.2 Number the swipes for identification.

Deleted: 13

7.5.3 Using a swipe, rub lightly an area of 100 cm^2 of potential contamination.

7.5.4 If the surface monitored was wet, let the swipe dry or dry the swipe in a microwave oven before counting.

7.5.5 Place the swipe on a clean flat surface and count the alpha emission rate using the portable alpha meter as outlined in the Total Alpha Contamination Survey sub-procedure in section 7.4, above. Alternately, count the swipe in a Ludlum model 2000 scaler/43 series alpha swipe counter or similar instrument.

7.5.6 Subtract the background cpm reading observed during the survey. Multiply the result by the correction factor and record on Form RH-120A under the Removable Alpha dpm/100 cm^2 column.

7.6 ***TOTAL BETA-GAMMA CONTAMINATION SURVEY***

7.6.1 Perform Beta-Gamma Survey Instrument Check sub-procedure outlined in section 7.3, above.

7.6.2 If the item to be monitored is wet, dry the item prior to conducting the beta-gamma survey.

7.6.3 Survey the surface.

7.6.3.1 Position the pancake probe of the survey meter using a contaminated equipment-to-detector distance similar to the calibration source-to-detector distance used above. (If alpha contamination is expected, a piece of paper can be placed between the probe and the surface being monitored to shield out the alpha particles).

7.6.3.2 Minimize touching the probe face with the surface being surveyed to avoid the possibility of contaminating the probe face.

7.6.3.3 Slowly (~1 cm/sec) move the probe over the area to be surveyed stopping at areas of suspect contamination to obtain an accurate determination of the level of contamination. Note increases in the count rates as indicated by the instrument's audible output.

7.6.3.4 Survey several different areas, to obtain an average count rate and a maximum count rate.

7.6.4 Subtract the background reading from the reading observed during the survey and multiply by the pancake correction factor. Record the readings obtained in the Total Beta-Gamma column of Form RH-120A or equivalent.

7.7 ***REMOVABLE BETA-GAMMA CONTAMINATION SURVEY***

7.7.1 Measure for removable activity only if the Total Beta-Gamma Activity exceeds the appropriate removable activity release limit.

7.7.2 Number the swipes for identification.

7.7.3 Using a swipe, rub lightly an area of 100 cm^2 of potential contamination.

7.7.4 If the surface monitored was wet, let the swipe dry or dry the swipe in a microwave oven before counting.

Deleted: 13

7.7.5 Place the swipe in the pancake probe holder or on a clean flat surface and count the beta-gamma emission rate as outlined in the Total Beta-Gamma Contamination Survey sub-procedure in section 7.6, above). Alternately, count the swipe in an Eberline model BC-4 beta-gamma swipe counter or similar instrument.

7.7.6 Multiply the observed reading less the background reading by the pancake probe efficiency. Record the measurements in the removable beta/gamma column of Form RH-120A or equivalent.

7.8 AREA SURVEYS

Routine area contamination surveys shall be performed at several designated areas at the Mill facility as directed by the RSO.

7.8.1 Areas to be routinely surveyed will include clean areas within the restricted area (such as the lunch room), controlled areas (such as contamination or airborne radioactivity areas), process areas within the restricted area, and unrestricted areas in the Mill facility (such as the change room).

7.8.2 Unrestricted areas and clean areas shall be decontaminated immediately if found to exceed the unrestricted use release limits as specified in Procedure RH-070, Table A1. The release limits for equipment for alpha or beta in unrestricted areas are:

7.8.2.1 15,000 dpm/100 cm^2 max;

7.8.2.2 5,000 dpm/100 cm^2 average; and

7.8.2.3 1,000 dpm/100 cm^2 removable.

7.8.3 Contamination of materials, equipment and surfaces that remain within the restricted area shall be maintained at less than 10^{-3} Ci/cm^2 (220,000 dpm/100 cm^2).

7.8.3.1 Surfaces exceeding this limit generally occur only in yellowcake drying and packaging areas and contamination is visible to the naked eye.

7.8.3.2 Visible contamination in the Mill facility is decontaminated immediately in accordance with the General Housekeeping Maintenance Procedure MP-010 (see the Facility operating Plan).

7.9 *RESULTS AND DOCUMENTATION*

7.9.1 If the survey measurements exceed the appropriate release limits specified by the appropriate procedure, perform decontamination in accordance with the Decontamination Procedure RH-020.

7.9.2 Following decontamination efforts, resurvey and document results on Form RH-120A or equivalent.

7.9.3 In the event that decontamination is not successful, notify the RSO or Alternate RSO for assistance.

7.9.4 Enter the following data on Form RH-120A or its equivalent:

7.9.4.1 Equipment description;

Deleted: 13

7.9.4.2 Area surveyed or name of person surveyed;

7.9.4.3 Technician conducting the survey (if not self-survey);

7.9.4.4 Date and time of survey;

7.9.4.5 Location where survey is conducted;

7.9.4.6 Survey equipment serial number for both the alpha and beta-gamma surveys;

7.9.4.7 Date the equipment was calibrated; and

7.9.4.8 Results of survey.

7.9.5 The RSO or Alternate RSO shall review and sign the Form RH-120 or equivalent.

7.9.6 The Alternate RSO or designee shall file Form RH-120A or equivalent in the Safety Department Records.

7.9.7 Retain Form RH-120A or equivalent for 3 years.

Alpha and Beta-Gamma Contamination Surveys Procedure RH-120

Appendix A

Alpha/Beta-Gamma Contamination Survey Report Form RH-120A

Alpha/Beta-Gamma Contamination Survey Report Form

Date of Survey: _____ Reviewed by: _____ Location: Piñon Ridge Mill

Name of Surveyor: _____ Date: _____

Employee Number: _____ Employee Number: _____

Signature: _____ Signature: _____

Alpha Instrument
Type _____ Background Activity _____
SN _____ Alpha MDA _____
Calibration Date _____ Alpha Correction Factor _____

Beta-Gamma Instrument
Type _____ Background Activity _____
SN _____ Beta-Gamma MDA _____
Calibration Date _____ Beta-Gamma Correction Factor _____

Potential Location[1]	Total Alpha Activity (dpm/100cm^2)	Removable Alpha Activity (dpm/100cm^2)	Total Beta-Gamma Activity (dpm/100cm^2)	Removable Beta-Gamma Activity (dpm/100cm^2)	Was Supervisor Notified?	Was Area Cleaned?	Final Reading (dpm/100cm^2)

Potential Location[1]	Total Alpha Activity (dpm/100cm^2)	Removable Alpha Activity (dpm/100cm^2)	Total Beta-Gamma Activity (dpm/100cm^2)	Removable Beta-Gamma Activity (dpm/100cm^2)	Was Supervisor Notified?	Was Area Cleaned?	Final Reading (dpm/100cm^2)

1) See the attached diagram of the radiological area boundaries on the following sheet.

Diagram of the Radiological Area Boundaries

Deleted: 13

1.0 PURPOSE

This procedure is for the measurement of radioactive airborne particulate concentrations at the Piñon Ridge Mill to establish:

1.1 Working locations where airborne concentrations are As Low As Reasonably Achievable (ALARA),

1.2 The need for respiratory protection, and

1.3 Trends in workers' radiation doses from long-lived airborne radionuclides.

2.0 APPLICABILITY

General area air particulate grab sampling will be used in areas of the Mill where potential exists that employees could be exposed to air concentrations at or above 10% of the applicable Derived Air Concentration (DAC) for both long-lived radionuclides. Radon progeny monitoring is addressed in Procedure RH-140. Breathing zone air sampling is addressed in Procedure RH-150.

3.0 OTHER DOCUMENTS

3.1 *REFERENCES*

3.1.1 NRC Regulatory Guide 8.25, Air Sampling in the Workplace.

3.1.2 NRC Regulatory Guide 8.30, Health Physics Surveys in Uranium Recovery Facilities.

3.1.3 Posting Procedure RH-030.

3.1.4 Radiation Exposure Action Limits Procedure RH-040.

3.1.5 Radionuclide Concentrations in Air Samples Procedure RH-302.

3.1.6 Piñon Ridge Mill Emergency Response Plan

3.1.7 Colorado Rules and Regulations Pertaining to Radiation Control Part 4 (6 CCR 1007-1).

3.2 *APPENDICES*

Appendix A – General Air Sample Data Form RH-130A

4.0 EQUIPMENT AND MATERIALS

4.1 *EQUIPMENT*

4.1.1 Eberline RAS-1 air sampler**,** or the equivalent sampler capable of sampling at approximately 30 liters per minute (lpm).

4.1.2 Breathing zone air sampler may be used in areas where electrical power is not available or as specified by the Radiation Safety Officer (RSO) or Alternate RSO (See the Occupational Breathing Zone Monitoring Procedure RH -150)

APPROVALS	*Signature*	*Date*
RSO		
Plant Manager		

Deleted: 13

4.2 ***MATERIALS***

4.2.1 47 mm, glass fiber filter sized to fit the Eberline RAS-1 air sampler, or the equivalent.

4.2.2 37 mm membrane filter for the breathing zone type sampler, if used.

5.0 RESPONSIBILITY

5.1 The RSO or the Alternate RSO is responsible for:

5.1.1 Identifying and assigning the locations for sampler placement and frequency of sampling to the Radiation/Security Technicians (RSTs).

5.1.2 Training the RSTs on occupational air sampling.

5.1.3 Reviewing data from the general air samples, determining the needs for respiratory protection, and if necessary, taking any corrective actions.

5.2 The Radiation/Security Technician (RST) is responsible for:

5.2.1 Collecting the general air samples according to the schedule and frequency provided by the RSO.

5.2.2 Insuring that the equipment used for this sampling is properly calibrated and maintained.

5.2.3 Following the procedures contained herein to accomplish the sampling.

5.2.4 Informing the RSO or Alternate RSO of any deviations or problems that were encountered during sampling activities.

5.2.5 Retaining forms for a minimum of 3 years (6 CCR 1007-1 4.42.1).

6.0 PREREQUISITE INFORMATION

6.1 ***DEFINITIONS***

6.1.1 General Air Samples - Air samples from the area of the Mill where personnel are working with radioactive materials. The general air samples are collected in the airflow pathway downstream of the sources of airborne radioactive material and between the source and the worker. "These samples do not have to be placed near the worker's breathing zone (within about 1 foot of the worker's head) and thus concentrations (measured by general air samples) might be considerably different from the concentrations in the breathing zone." (Reg. Guide 8.25, pages 4-5).

6.1.2 Mobile Air Particulate Sampler –Air sampler which can be moved to various locations to measure airborne concentrations.

6.1.3 Breathing Zone Air Particulate Sampler – A portable, battery operated air pump and filter cassette worn by the worker to measure concentrations of particulates in the vicinity of the "breathing zone" since the filter cassette is typically attached to a shirt lapel.

6.2 ***SAFETY***

6.2.1 Care should be taken to avoid electrical shock. Samplers should be placed where water cannot come in contact with the pump or power cords.

6.2.2 Intrinsically safe equipment shall be used in locations where potential explosion hazards.

Deleted: 13

6.2.3 Place power cords in positions where they are not tripping hazards.

6.3 ***FREQUENCY***

6.3.1 Weekly, monthly, or quarterly air particulate samples based on percent of applicable Derived Air Concentration (DAC).

6.3.1.1 Concentration >25% DAC = Daily

6.3.1.2 Concentration >10% and <25% DAC = Weekly

6.3.1.3 Concentration <10% DAC = Monthly

6.3.2 The RSO or Alternate RSO is to determine the locations, sampling frequencies and parameters to be analyzed. He/she is to convey that information to the RST. Criteria for the types and frequency of general air particulate sampling are provided in Table 1.

6.3.3 Criteria for the RSO to establish the sampling locations are:

6.3.3.1 General air samples should be collected in airflow pathways downstream from sources of airborne radioactive material and between the source and the worker. Periodic airflow pattern studies (smoke or similar studies) shall be performed as needed to determine downwind locations for proper placement of air samplers where airflow is uncertain or difficult to determine through observation alone.

6.3.3.2 Sampling locations should be as close to the frequently occupied work locations as practical without interfering with work.

6.3.3.3 Air samples intended to measure workplace concentrations should not be located in or near exhaust ducts because of the usual diluting effect of the exhausts.

6.3.4 For materials not listed in Table 1, a work plan and/or RWP may specify material-specific DACs, sampling locations and frequencies.

Table 1
Summary of Air Particulate Survey Frequencies and Type

Type of Survey	Type of Area	DAC[(a)]	Frequency and Type of Survey[(b)]	LLD[(c)]
Uranium ore dust	Airborne Radioactivity Area	>DAC	Daily 30-minute grab samples at ~30 lpm in worker occupied areas	3E -12 µCi/ml (uranium)
Uranium ore dust	Ore handling area indoors or Ore pad	>10% and <25%	Weekly 30-minute grab sample at ~ 30 lpm in worker occupied areas	3E -12 µCi/ml (uranium)
Uranium ore dust	Ore handling area indoors or Ore pad	<10%	Monthly 30-minute grab sample at ~30 lpm in worker occupied areas	3E -12 µCi/ml (uranium)

Deleted: 13

Type of Survey	Type of Area	DAC[(a)]	Frequency and Type of Survey[(b)]	LLD[(c)]
Uranium ore dust	Ore pad	>10%	Breathing zone grab sample if front-end loader generates visible ore dust	3E -12 µCi/ml (uranium)
Yellowcake	Special maintenance involving high airborne concentrations of yellowcake	≥DAC	Continuous breathing zone air monitoring (See Procedure RH-150) (Analyze samples before end of next shift).	3E -11 µCi/ml
Yellowcake	Special maintenance involving high airborne concentrations of yellowcake	>12 DAC-hrs per week	Breathing zone grab samples (See Procedure RH-150)	3E -11 µCi/ml
Yellowcake	Airborne Radioactivity Area or soluble uranium area	>10%	Daily 30-minute grab samples at ~30 lpm in worker occupied areas	3E -11 µCi/ml
Yellowcake	Other indoor process areas	>10% and <25%	Weekly 30-minute grab sample at ~ 30 lpm in worker occupied areas	3E -11 µCi/ml
Yellowcake	Other indoor process areas	<10%	Monthly 30-minute grab sample at ~30 lpm in worker occupied areas	3E -11 µCi/ml

(a) Derived air concentration (DAC). See Reg. Guide 8.25. See Procedure RH-300 for material specific DACs.
(b) Type and frequencies of sampling recommended in Reg. Guide 8.25 and 8.30. Alternatively, a grab sample may consist of a 5-minute high-volume sample at ~850 liters per minute (lpm), which is equivalent to 30 cubic feet per minute (cfm). Breathing zone air sampling is included in Table 1 to demonstrate when general air samples are not sufficient.
(c) LLD = Established at ≤ 10% of the applicable DAC per NRC Regulatory Guide 8.30; DAC values from Colorado Rules and Regulations Pertaining to Radiation Control (6 CCR 1007-1), Part 4, Table 4B including footnote 3 for natural uranium in ore dust

6.3.5 General air particulate samples may be collected during or following an emergency incident (see the Mill Emergency Response Plan) at the discretion of the RSO or Alternate RSO.

7.0 PROCEDURE

7.1 The RST is to collect the area samples at locations and at the frequencies specified by the RSO or Alternate RSO. Sample the work area for a minimum of 30 minutes at approximately 30 liters per minute or equivalent volume using a breathing zone type air sampler.

Deleted: 13

7.2 The RST is to check the sampling equipment for visible damage and operational status before each use.

7.3 Calibration of the air samplers flow rate is required at least once per quarter. Verify that the calibration is current. A tag attached to the sampler notes when the latest calibration was performed.

7.3.1 If the calibration is out of date, remove the sampler from service and tag as out of use until recalibrated.

7.3.2 If calibration is current the instrument should be visually inspected for loose fittings and electrical connections. If this inspection reveals any obvious problems the sampler should be removed from service and repaired.

7.4 At the assigned sampling location install a 47 mm glass fiber filter or equivalent in the sampler filter holder. Assure that the filter is installed correctly to provide a good seal on the filter media.

7.5 Turn on the sampler and check for airflow being drawn in through the sample holder. Adjust the air sampler flow rate to the desired set point as indicated on the sampler rotometer. The set point value is noted on the calibration tag attached to the air sampler.

7.6 At the completion of sampling, recheck the sampler flow rate as indicated on the rotometer and record any difference from the initial setting. Turn off the sampler, remove the sampler filter, and place the filter in a petri dish or envelope.

7.7 The RST is to mark the top of the sample collection petri dish or envelope with:

7.7.1 Sample ID number

7.7.2 Date and time of collection

7.7.3 Location ID Number – As indicated in sample location diagram included with Form RH-130A

7.8 The RST is to fill in the following information on the General Air Sample Data Form:

7.8.1 Sample ID number

7.8.2 Location ID number

7.8.3 Date and start and end times of collection

7.8.4 Sample collection minutes

7.8.5 Start and end sampler flow rates

7.8.6 Total volume sampled

7.8.7 Sampling instrument number

7.8.8 Area operational status

7.8.9 Ventilation conditions at time of collection

7.8.10 Status of emission control equipment

7.9 After completing the day's sampling, the RST is to turn in samples to the Mill or contract laboratory for analysis of gross alpha and/or total U, Th-230, Ra-226, and Th-232 based on the requirements in Procedure RH-300.

Deleted: 13

7.10 Sample analysis procedures are specified in the Laboratory Procedures Manual.

7.11 The RSO or Alternate RSO is to review the measured concentrations, compare them to the DAC for specific areas and type of ore being processed (See Procedure RH-302), and assess the need for additional engineering controls to maintain radiation exposures to As Low As Reasonably Achievable (ALARA). This assessment will determine:

7.11.1 The need for respiratory protection;

7.11.2 The type of respirator for the area;

7.11.3 The need for breathing zone samplers;

7.11.4 The need to change area postings as a result of the air sampling data; and

7.11.5 Compliance with Radiation Work Permits.

7.12 The RST is to file and retain the results for a minimum of three years.

Occupational General Air Particulate Survey Procedure RH-130

Appendix A

General Air Sample Data Form RH-130A

General Air Sample Data Form

RWP-_____ Sampler Name _____ Employee Number _____

Sampler Signature _____ Date _____

Location ID Number[2]	Sample ID Number	Sample Date	Time			Flow Rate			Sampling Instrument Number	Total Volume (liters)	P (Y/N)	V (Y/N)	E (Y/N)
			Start	Finish	Total (minutes)	Start (lpm)	Stop (lpm)	Average[1] (lpm)					
COMMENTS:													

1) Average Air Flow calculated using arithmetic method
2) See Attached Sample Location Diagram
P = Production area, V = Visible dust, E = Emission control equipment in operation

Reviewed by _____Employee Number _____

Signature _____ Date _____

Form RH-130A

SAMPLE LOCATION DIAGRAM

Form RH-130A

Deleted: 13

1.0 PURPOSE

This procedure is for the measurement of radioactive airborne particulates concentrations in the breathing zone of employees and contractors at the Piñon Ridge Mill to establish:

1.1 Concentrations of uranium and progeny in air to which workers are potentially exposed,

1.2 The need for respiratory protection, and

1.3 Trends in workers' radiation doses from airborne radionuclides.

2.0 APPLICABILITY

Breathing zone air particulate samplers are used in worker occupied areas where an employee is potentially exposed to airborne concentrations of radionuclides in excess of 10% of applicable DACs. (e.g., for natural uranium @ 10% of 3 E-10 µCi/ml or radon progeny @ 10% of 0.3 working levels)

3.0 OTHER DOCUMENTS

3.1 *REFERENCES*

3.1.1 U.S. Nuclear Regulatory Commission Regulatory Guide 8.25, Air Sampling in the Workplace.

3.1.2 U.S. Nuclear Regulatory Commission Regulatory Guide 8.30, Health Physics Surveys in Uranium Recovery Facilities.

3.1.3 Colorado Rules and Regulations Pertaining to Radiation Control, Part 4 (6 CCR 1007-1)

Deleted: Regulations

3.1.4 Piñon Ridge Mill Emergency Response Plan

3.2 *APPENDICES*

Appendix A – Breathing Zone Sample Issue/Collection Report Form RH-150A

4.0 EQUIPMENT AND MATERIALS

4.1 *EQUIPMENT*

4.1.1 SKC Model PCXR4 or Gillian GilAir 5 air pumps or equivalent.

4.1.2 Cleaning containers, brushes.

4.2 *MATERIALS*

4.2.1 37 mm membrane filter paper/support pads, or the equivalent.

4.2.2 Form RH-150A, or the equivalent.

4.2.3 Breathing Zone Cassette label, or the equivalent.

4.2.4 Soap solution, acidic cleaning solution (e.g. EDTA), or the equivalent.

4.2.5 Dilute HCl solution.

APPROVALS	*Signature*	*Date*
RSO		
Plant Manager		

Deleted: 13

5.0 RESPONSIBILITIES

5.1 The Radiation Safety Officer (RSO) or the Alternate RSO is responsible for:

5.1.1 Identifying and assigning the locations or job categories for sampler use and frequency of sampling to the Radiation/Security Technicians (RST).

5.1.2 Training the RSTs on occupational air sampling.

5.1.3 Reviewing data from the breathing zone samples, determining the needs for respiratory protection, and if necessary, taking corrective actions.

5.1.4 Insuring that non-routine monitoring, such as during maintenance repair operations, are accomplished under a Radiation Work Permit (RWP).

5.2 The Radiation/Security Technician (RST) or designee is responsible for:

5.2.1 Collecting the breathing zone samples according to the schedule and frequency provided by the RSO or Alternate RSO.

5.2.2 Insuring that the equipment used for sampling is properly calibrated and maintained.

5.2.3 Following this procedure.

5.2.4 Informing the RSO or Alternate RSO of any deviations or problems that were encountered during sampling activities.

5.2.5 Laboratory analyses of the breathing zone samples.

5.2.6 Retaining forms for 3 years.

6.0 PREREQUISITE INFORMATION

6.1 *DEFINITIONS*

6.1.1 Breathing Zone Air Survey – Monitoring of airborne radioactive particles generally within 1 foot of the individual's head (Regulation Guide 8.25, pages 4-5) using a belt worn, battery operated air pump connected to a filter and filter head usually clipped on the workers' lapel.

6.1.2 DAC – Derived Air Concentration.

6.2 *SAFETY*

Care should be taken not to catch the tygon tube, from the belt-worn air pump to the lapel filter holder, on process equipment.

6.3 *FREQUENCY*

6.3.1 Continuous breathing zone air samplers will be required to be worn when exposure to uranium or radon progeny is or could be ≥ 10% of the DAC as directed by the RSO or Alternate RSO.

6.3.2 Breathing zone air samplers may be worn by emergency response personnel (both Mill and off-site) during an emergency incident (see the Mill Emergency Response Plan) at the discretion of the RSO or Alternate RSO. Participation by non-Mill personnel is voluntary.

7.0 PROCEDURE

7.1 The RSO or Alternate RSO is to determine the locations, sampling frequencies and parameters to be analyzed. He is to convey that information to the RSTs.

Deleted: 13

7.2 The RST is to check the sampling equipment for visible damage and operational status prior to use. Before issuing a breathing zone sampler, the RST is to perform the following operational checks:

7.2.1 Calibration of the breathing zone sampler flow rate is required at least once per quarter. Verify that the calibration of the breathing zone sampler is current. A tag attached to the sampler notes when the latest calibration was performed.

7.2.2 If the calibration date of the sampler is not current, remove the sampler from service for calibration and notify the Safety Department.

7.2.3 Select a different breathing zone sampler if the sampler calibration is not current.

7.2.4 Check the battery pack of the pump unit for charge level.

7.2.5 Briefly turn on the sampler to verify operation. If the sampler fails to run correctly, select a different sampler for issue and notify the Safety Department.

7.2.6 Check the sample line from the pump to filter holder for splits or cracks, replacing if warranted.

7.2.7 Check filter gasket, replacing if worn or visible defects are observed.

7.2.8 Prior to installing the filter, check for sample line leaks by plugging the sample line at the filter end. Air flow through the pump should be nil.

7.2.9 When the above operational checks are completed and the sampler is deemed operational for use, it is ready for issue.

7.3 The RST is to install an assembled filter cassette. If monitoring for more than one day or shift, reinstall the appropriate filter cassette for that person.

7.3.1 New cassettes are received from the supplier preloaded.

7.3.2 Previously used cassettes are cleaned and decontaminated, allowed to dry and then reloaded with a new support pad, filter and then reassembled for use as follows:

7.3.2.1 Remove any remaining labels, tape, etc. from the cassettes and check for damage.

7.3.2.2 Discard cassettes that have cracks, splits etc.

7.3.2.3 Separate the inlet and outlet sections of the cassettes and place in to cleaning containers.

7.3.2.4 Add tap water, cleaning soap such as Alconox, and EDTA. Make sure all cassettes are covered with solution, and stir occasionally. Soak for approximately 8 hours.

7.3.2.5 Scrub cassettes using a stiff bristle brush to remove any remaining residue, labels, tape etc.

7.3.2.6 Place the soap-cleaned and scrubbed cassettes into a container and rinse twice with tap water and drain.

7.3.2.7 Refill containers with tap water and add 10-20 ml of HCl acid. Add HCl to water not water to HCL.

Deleted: 13

7.3.2.8 Soak cassettes in HCL solution for approximately 4 hours.

7.3.2.9 Drain HCL solution from containers and thoroughly rinse twice with tap water. Drain.

7.3.2.10 Perform final rinse of cassettes using reagent grade water and drain.

7.3.2.11 Remove cassettes from containers and place on clean tray lined with paper towels making sure to place the cassettes open end face down.

7.3.2.12 Place paper towels between layers of cassette as needed.

7.3.2.13 After the cassettes have thoroughly dried, install a new filter support pad and membrane filter on top of pad using tweezers or forceps.

7.3.2.14 Reassemble cassettes and seal the inlet and outlet opening of the cassettes with plugs or electrical tape.

7.3.2.15 Check to make sure cassette sections are seated together. A small hammer and socket can be used to seat the two sections.

7.3.2.16 Try twisting the two sections. If they are loose, seal the two section halves using electrical tape.

7.3.2.17 Place reassembled cassette into storage box for later use.

7.4 The RST is to attach the breathing zone filter cassette on to the sampling hose attached to the pump and verify that the sampler filter cassette is installed correctly. The breathing zone cassette is two or three pieces with one side marked as the inlet. The side of the cassette marked inlet is the particulate collection side. Attach the pump sampling line to the opposite side of the cassette, which looks like a wagon wheel.

7.5 The RST is to remove the cassette inlet plug.

7.6 The RST is to turn on the sampler.

7.7 The RST is to check and adjust the sampler flow rate to the value noted on the calibration sticker attached to the sampler.

7.8 The employee is to be issued the breathing zone sampler prior to reporting to their assigned work area.

7.9 The RST is to attach the sampling line with cassette installed on to the employee's shirt collar etc. or other locations near the workers breathing zone (1 foot from worker's head).

7.9.1 When coveralls, wet/chemical suits or coats, etc., are worn make certain the breathing zone cassette is attached to the outside of the outer clothing.

7.9.2 The cassette should be attached to the wearer so the particulate inlet to the cassette is facing downward.

7.10 The RST is to record data needed on Form RH-150A or equivalent prior to each time a sampler is issued. The items are to include.

7.10.1 Breathing Zone Sample Identification Number

7.10.2 Start date of sampler

Deleted: 13

7.10.3 Start time of sampler

7.10.4 Air Sampler used

7.10.5 Name of employee being sampled

7.10.6 Employee number

7.10.7 Routine or special sample

7.10.8 When the cassette is to be worn for more than one day, the information is to be recorded on the same sheet for that person for that sample cassette

7.11 The employee is to wear the sampler for the intended amount of time with it in operation. If the sampler shuts down or flow faults during the wearing period, the employee is to contact the RST who is to:

7.11.1 Ask the wearer the estimated time the sampler faulted.

7.11.2 Record all information on Form RH-150A or equivalent.

7.11.3 Restart the breathing zone sampler and document restart time on Form RH-150A or equivalent.

7.12 The employee, after the intended amount of time or end of shift with the breathing zone sampler in operation, is to return to the location where the sampler was initially issued to have the sampler collected by the RST.

7.13 The person collecting the samplers is to record the following information on Form RH-150A or equivalent.

7.13.1 If the indicated flow rate on the sampler is different than that noted on the calibration sticker, record the rate at which the sampler is presently operating.

7.13.2 Record stop date and time.

7.13.3 Record sampler elapsed timer reading.

7.13.4 Turn off the sampler.

7.13.5 Reinstall the cassette inlet plug and carefully remove the breathing zone cassette from the pump sample line if the sampler is not going to be reissued to the same employee for use during their next work shift.

7.13.6 Ask the wearer of the sampler the following questions and record their answer on Form RH-150A or equivalent.

7.13.6.1 Was respiratory protection worn? If so how long was the respiratory protection worn? Record what type of mask was used.

7.13.6.2 Were other workers performing the same task that did not have a breathing zone sampler?

7.13.6.3 Were there any unusual circumstances encountered when wearing the sampler?

7.14 The person who was issued and wearing the breathing zone sampler must sign Form RH-150A or equivalent verifying the information provided was accurate.

Deleted: 13

7.15 The RST receiving the breathing zone sampler is to proceed with the following:

7.15.1 Visually inspect the filter inside the breathing zone cassette. Note on Form RH-150A or equivalent the appearance of the filter (clean, discolored, etc).

7.15.2 Store the cassette so the particulate inlet side of the sample cassette is facing upwards.

7.15.3 Inspect the sample pump and hose for any visible damage. If damage is noted, document it on Form RH-150A or equivalent, determine how the damage occurred, and replace the damaged part.

7.15.4 Place the breathing zone sampling pump on to the battery charger or replace the discharged battery with a charged one.

7.16 The RST retrieving the breathing zone sample filters that need to be analyzed is to:

7.16.1 Maintain custody of the filters that are being sent to the laboratory for analysis.

7.16.2 Label a filter-transfer envelope to identify the sample. Place the samples in the filter-transfer envelop and transfer to the laboratory for analysis.

7.17 The RSO is to review the results of the laboratory analyses for accuracy and completeness. The RSO is to sign the reports to signify his review and understanding of the report and file the report.

8.0 DOCUMENTATION

8.1 The RSO or Alternate RSO shall review and sign the Form RH-150A or equivalent.

8.2 The Alternate RSO or designee shall file Form RH-150A or equivalent in the Safety Department Records.

8.3 Retain Form RH-150A or equivalent until license termination.

Occupational Breathing Zone Monitoring Procedure RH-150

Appendix A
Breathing Zone Sample Issue/Collection Report Form

Breathing Zone Sample Issue/Collection Report Form

User Name _____ Employee ID _____ Dept/Company _____ Special ____ Routine ____

Signature _____ Date _____

Pump #	Date	Time On	Time Off	Timer Reading (min)	Run time Per On/Off Times (min)	Run time used for calculations (min)	Filter Inspection Comments	Respirator Type and Total Time Worn	Work Area Code or Task	Unusual Circumstances	Other Workers Performing Same Task	Wearer Initials

RADIATION SAFETY DEPARTMENT USE ONLY

BZ#	Sample Submittal #	Lab #	Flow Rate (lpm)	Total time (min)	Total Volume (liters)	Remarks	Radiation Tech Initials

Respirator Type: HF: Half Face FF: Full Face AL: AirLine RH: Racal Helmet RFF: Racal Full Face

Comments _____

_____

_____

Surveyed Performed by _____ Employee ID _____

Signature _____ Date _____

Reviewed by _____ Employee ID _____

Signature _____ Date _____

Form RH-150A

Deleted: 14

1.0 PURPOSE

This procedure provides guidance and instruction for the use of personnel dosimeters by workers to determine estimates of external exposure to ionizing radiation at the Piñon Ridge Mill.

2.0 APPLICABILITY

Personal radiation dosimeters are issued to individuals at the Mill to provide an exposure estimate from external gamma radiation. As part of the As Low As Reasonably Achievable (ALARA) program, employees and contractors at the facility are issued Thermoluminescent Dosimeters (TLD) or Optically Stimulated Luminescence Dosimeters (OSL) if there is a potential that their dose from gamma rays could exceed 10% or more of the applicable radiation dose limit, i.e. 500 mrem/year.

3.0 OTHER DOCUMENTS

3.1 *REFERENCES*

3.1.1 NRC Regulatory Guide 8.30, Health Physics Surveys in Uranium Recovery Facilities.

3.1.2 Colorado Rules and Regulations Pertaining to Radiation Control, Parts 4 and 10 (6 CCR 1007-1).

3.1.3 Radiation Exposure Action Levels Procedure RH-040

3.1.4 Piñon Ridge Mill Emergency Response Plan

3.2 *APPENDICES*

Appendix A – Lost or Broken TLD/OSL Badge Report Form RH-210A

4.0 EQUIPMENT AND MATERIALS

4.1 *EQUIPMENT*

4.1.1 Thermoluminescent Dosimeter (TLD) or Optically Stimulated Luminescent Dosimeter (OSL)

5.0 RESPONSIBILITY

5.1 The Radiation Safety Officer (RSO) is responsible for:

5.1.1 Assuring that TLD/OSL badge vendor is NVLAP certified.

5.1.2 Reviewing the TLD/OSL Occupational Radiation Exposure Report and the Occupational Exposure Record for a Monitoring Period.

5.1.3 Investigating any exposure results exceeding the action level guidelines. Refer to the Radiation Exposure Action Levels Procedure RH-040 for specific action levels associated with elevated dosimeter badge readings.

5.1.4 Determining any corrective actions that should be put into affect based on the investigation.

5.1.5 Reviewing the Lost or Broken TLD/OSL Badge Report (as needed) and the Lost Badge Report (yr) Spreadsheet (quarterly).

APPROVALS	*Signature*	*Date*
RSO		
Plant Manager		

Deleted: 14

5.2 The Alternate RSO is responsible for:

5.2.1 Verifying shipment of received and shipped TLD/OSL badges.

5.2.2 Issuing TLD/OSL badges to the Safety/Security Technicians at the beginning of each new quarter.

5.2.3 Tracking lost and/or broken TLD/OSL badges.

5.2.4 Distributing the Occupational Exposure Record for a Monitoring Period.

5.2.5 Notifying the dosimetry vendor of additions to and deletions from the list of personnel designated to receive TLD's/OSL's.

5.2.6 Issuing to or receiving badges from personnel and storing the TLD/OSL badges at the guard shack.

5.2.7 Exchanging the badges once per quarter or when specified by the RSO.

5.2.8 Completing the Lost or Broken TLD/OSL Badge Report when a badge is reported lost or damaged.

5.3 Each Individual issued a radiation monitor is responsible for:

5.3.1 Wearing the badge while at work at the Mill.

5.3.2 Reporting lost or damaged badges to the Safety/Security Technician.

6.0 PREREQUISITE INFORMATION

6.1 *DEFINITIONS*

6.1.1 TLD – Thermoluminescent Dosimeter

6.1.2 OSL – Optically Stimulated Luminescent Dosimeter

6.1.3 NVLAP – National Voluntary Laboratory Accreditation Program

6.1.4 DDE – Deep Dose Equivalent

6.1.5 SDE – Shallow Dose Equivalent

6.1.6 LDE – Lens Dose Equivalent

6.1.7 EDE – Extremity Dose Equivalent

6.2 *FREQUENCY*

6.2.1 TLD/OSL badges are exchanged on a quarterly basis or more frequently as may be required by a Radiological Work Permit (RWP) and/or at the discretion of the RSO.

6.2.2 TLD/OSL badges may be issued to visitors at the discretion of the RSO dependent on the areas a visitor will be accessing and the length of time the visitor will be in those areas.

6.2.3 TLD/OSL badges may be issued to emergency response personnel (both Mill and off-site) during an emergency incident (see the Mill Emergency Response Plan).

7.0 PROCEDURES

7.1 *ISSUANCE OF RADIATION DOSIMETERS*

7.1.1 Prior to issuance of a dosimeter, the RSO or Alternate RSO shall verify

Deleted: 14

that individuals have received applicable training.

7.1.2 Individuals are issued personal radiation monitors by and shall return the monitors to the Alternate RSO or Radiation/Security Technician.

7.1.3 When not worn, TLD/OSL badges are stored on a badge board in the guard house.

7.1.4 Each TLD/OSL badge is identified by a unique badge number assigned by the vendor along with the name of the employee.

7.1.5 TLD/OSL badges or dosimeters should be worn on the trunk of the body, at or above the waist for whole body exposure estimates.

7.1.6 A minimum of two TLD/OSL control badges are stored along with the individual TLD/OSL badges at the guard house.

7.2 READING OF TLD/OSL BADGES

7.2.1 TLD/OSL badges will be read by a NVLAP certified vendor.

7.2.2 The TLD/OSL vendor issues a quarterly Occupational Exposure Report for a Monitoring Period within thirty days from the end of the calendar quarter, and a summary Occupational Radiation Exposure Report within sixty days from the end of the calendar year, which contains the following:

7.2.2.1 Personnel Identification

7.2.2.2 Name

7.2.2.3 Badge Number

7.2.2.4 Social Security Number

7.2.2.5 Birth Date

7.2.2.6 Date of Badge Issue

7.2.2.7 Date of Badge Return

7.2.2.8 Dose measured for the reporting period, calendar quarter, calendar year, and lifetime occupational dose.

7.2.2.9 Deep Dose Equivalent (DDE)

7.2.2.10 Shallow Dose Equivalent (SDE)

7.2.2.11 Permissible accumulated dose.

7.2.3 In the event a measurement exceeds the action level (see the Action Levels Procedure RH-040):

7.2.3.1 The TLD/OSL vendor will notify the RSO, or the Alternate RSO by telephone.

7.2.3.2 A Dosimeter High Call List is also received, via fax, reviewed by the RSO, and retained in the files by the Alternate RSO.

7.2.3.3 An investigation will be undertaken which will either substantiate the occurrence of measurement or describe the conditions that caused the measurement to be non-representative of the exposure that the badge holder actually sustained. The investigation will consist of:

Deleted: 14

- Discussion with the TLD/OSL vendor to determine potential analytical causes for the high reading
- Interview and the badge holder to determine potential incidents that may have caused excess exposure to the badge and/or badge holder
- Review of employee records to determine potential work conditions that caused a high exposure to the badge and/or badge holder
- Follow-up investigative procedures as determined appropriate by the RSO or Alternate RSO to determine the validity of the measurement
- Investigative measures and documents shall be recorded in writing and filed in the Safety Department files
- In the event that the measurement is determined to be invalid, the TLD/OSL vendor shall be instructed by the RSO or Alternate RSO to issue a corrected or qualified report

7.2.4 In the event the measurement is valid and exceeds the action level, the RSO will initiate such corrective action as is necessary in his/her opinion to reduce the current exposure condition going forward for the individual involved (such as reassignment to another area or use of additional personal protective equipment).

7.2.5 An incident of exposure of an individual to radiation in excess of the maximum permissible dose stipulated by Radiation Regulations will be reported in writing to the Colorado Department of Public Health and Environment (CDPHE) within 30 days from the date of the discovery of such exposure or as required by 6 CCR 1007-1, Section 4.52. This report shall include the following:

7.2.5.1 The name, date of birth and social security number of the affected person(s)

7.2.5.2 The amount of exposure

7.2.5.3 The cause of the exposure

7.2.5.4 Corrective actions taken or planned to prevent reoccurrence.

7.3 ***NOTIFICATION AND REPORTS TO INDIVIDUALS***

Radiation exposure data for an individual and the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body of an individual shall be reported to the individual in writing as specified in 6 CCR 1007-1, Section 10.4.

7.3.1 Each individual will be provided with an annual report prepared in accordance with 6 CCR 1007-1, Section 4.18) of the dose received in that monitoring year if that individual:

7.3.1.1 Received an occupational dose greater than 100 mrem TEDE or

Deleted: 14

100 mrem to any individual organ or tissue; or

7.3.1.2 Requests an annual dose report.

7.3.2 A report of the worker's exposure to sources of radiation at the request of the individual who engaged in activities at the Mill.

7.3.3 Exposure data contained in reports submitted to CDPHE will also be concurrently provided to the subject individual.

7.3.4 Upon termination of employment from the Mill, a written report including the radiation dose received by a worker during the current year shall be provided upon request of the worker.

7.4 *DOCUMENTATION*

The Alternate RSO or designee shall file exposure reports, investigation reports, and notifications in the Safety Department Records and maintain them for 3 years.

7.5 *SPECIAL CONSIDERATIONS FOR BETA EXPOSURE*

Although the primary purpose of this procedure addresses monitoring and recording of the Deep Dose Equivalent (DDE) to workers from external gamma exposure, consideration may also need to be made in uranium mills for the potential for beta exposure (Shallow Dose Equivalent - SDE). This can occur when employees are exposed to "aged yellowcake" where sufficient time has elapsed from separation of the uranium from its ores resulting in growth of beta emitting progeny (e.g. Pa-234 and Th-234). This circumstance can potentially result in exposure to the skin and/or the extremities from extended close proximity to large quantities of aged yellowcake requiring provision for finger and/or wrist dosimeter badges to assess this potential exposure (as contrasted to the "whole body dosimeters" addressed by the previous sections of this procedure).

However, the "life cycle" of uranium through the milling process once extracted from ore is short (hours or days) and it requires approximately 4 months once extracted for equilibrium with these immediate beta emitting progeny to again reach equilibrium. Additionally, since the product is loaded and stored in steel drums immediately following precipitation and drying, the betas cannot exit the container causing exposure.

Accordingly, is highly unlikely that under conditions of routine operations or as a result of spills or maintenance activities, beta exposure rates to which workers could be exposed could result in shallow dose equivalents to the skin or the skin of extremities ≥ 10% of the limits per 6 CCR 1007-1, Section 4.6.1.2 requiring individual beta monitoring per Section 4.18.1.1. However, if these circumstances were to be identified, an ALARA analysis will be performed to evaluate needs for additional surveys and controls, including provisions for personnel beta monitoring (e.g., ring and/or wrist badges). (Note: 10 % of 50 rem/yr = 5 rem/yr)

Personal Radiation Dosimeters Procedure RH-210

Appendix A

Lost or Broken TLD/OSL Badge Report Form RH-210A

Lost or Broken TLD/OSL Badge Report Form

Employee Name _____ Company _____

Employee Number _____ Hire Date _____

Termination Date_____

Employee Signature _____ Date _____

WEARER _____ was not left in controlled area for the following reason:

LOST BADGE_____ BROKEN BADGE_____ LEFT ELSEWHERE_____

Describe the specific area, if known, where the badge/ring was left or lost:

_____

REMARKS: _____

SAFETY DEPARTMENT ONLY

If lost badge was found, complete the following:

Date Found _____ Area Found _____

If blank badge was issued, complete the following:

Badge Number_____ Date Issued _____

Reason for issue of blank badge: _____

_____

Alternate RSO or RST (Print Name)	Employee Number
Signature	Date
RSO (Print Name)	Employee Number
Signature	Date

Form RH-210A