# DURANGO RADON FLUX MEASUREMENTS

## SUMMARY REPORT

On August 4, 1990 Durango, Colorado completed requirements set forth in 40 CFR 61, (NESHAPS) subpart T. and H.P. Procedure RAC-025 Rev. 0. There were 140 measurements taken over the 61,314 square meter disposal cell. The average radon flux was 0.2 pico-Curies per square meter per second ($pCi/m^2$-s), well below the standard of 20$pCi/m^2$-s. Individual measurement results ranged from 0.1 to 4.4 $pCi/m^2$-s. This report presents all measurement data points, as defined by the approved H.P. Procedure RAC-025. Included in this report is the quality control duplicate count data for 20 percent of the sample measurements. A linear regression analysis was performed on these quality controlled data pairs which yielded an R squared value of 0.99843. This value demonstrates the reproducibility of the measurement results.

Also included in this report is a graphic display that illustrates the location of each valid measurement point on the Durango northing - easting coordinate system. This graphic display shows that the entire disposal cell was measured at evenly spaced intervals, as required by NESHAPS. A copy of H.P. Procedure RAC-025, Rev. 0 is also included in this report.

These measurement data clearly indicate that requirements set forth in 40 CFR 61, Subpart T have been met.



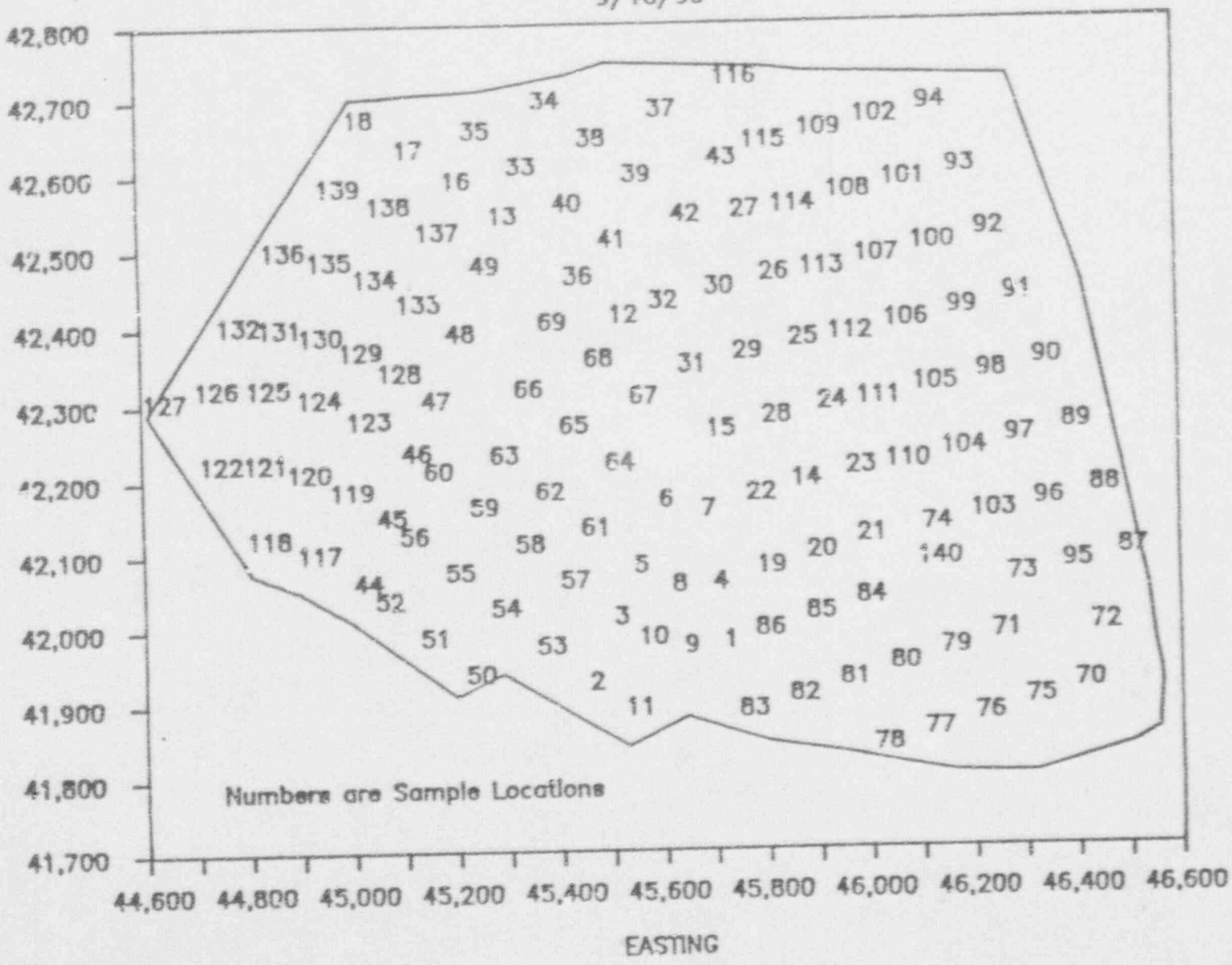
Mary C. Hood



91-0669

# DURANGO DISPOSAL CELL

9/18/90



9/13/90
DURANGO RADON FLUX SUMMARY DATA

| Sample # | Collected on (Julian Date) | Northing | Easting | pCi/M^2/s | ( QC ) |
|---|---|---|---|---|---|
| 1 | 168 | 41,983 | 45,729 | 0.0 | 0.1 |
| 2 | 172 | 41,929 | 45,470 | 1.3 | |
| 3 | 172 | 42,016 | 45,519 | 0.1 | 0.1 |
| 4 | 204 | 42,061 | 45,712 | 0.2 | |
| 5 | 204 | 42,085 | 45,559 | 0.8 | 0.8 |
| 6 | 204 | 42,172 | 45,608 | 0.2 | |
| 7 | 204 | 42,158 | 45,692 | 0.0 | |
| 8 | 204 | 42,059 | 45,633 | 0.3 | |
| 9 | 168 | 41,977 | 45,654 | 0.1 | |
| 10 | 170 | 41,989 | 45,580 | 0.2 | |
| 11 | 170 | 41,894 | 45,552 | 0.2 | |
| 12 | 207 | 42,416 | 45,534 | 0.7 | 0.7 |
| 13 | 207 | 42,546 | 45,305 | 0.2 | |
| 14 | 204 | 42,198 | 45,880 | 0.1 | |
| 15 | 201 | 42,265 | 45,718 | 0.1 | |
| 16 | 207 | 42,593 | 45,217 | 0.4 | |
| 17 | 207 | 42,636 | 45,126 | 0.4 | |
| 18 | 207 | 42,676 | 45,031 | 0.2 | |
| 19 | 204 | 42,082 | 45,810 | 1.1 | 1.1 |
| 20 | 204 | 42,102 | 45,908 | 0.1 | |
| 21 | 204 | 42,123 | 46,006 | 0.0 | |
| 22 | 204 | 42,180 | 45,793 | 0.1 | |
| 23 | 204 | 42,214 | 45,987 | 0.1 | |
| 24 | 201 | 42,299 | 45,934 | 0.4 | |
| 25 | 201 | 42,383 | 45,880 | 0.1 | |
| 26 | 201 | 42,468 | 45,826 | 0.2 | |
| 27 | 201 | 42,552 | 45,773 | 0.0 | |
| 28 | 201 | 42,282 | 45,826 | 0.1 | |
| 29 | 201 | 42,366 | 45,772 | 0.1 | |
| 30 | 201 | 42,451 | 45,719 | 0.0 | 0.0 |
| 31 | 201 | 42,349 | 45,665 | 0.8 | |
| 32 | 201 | 42,434 | 45,611 | 0.1 | |
| 33 | 201 | 42,611 | 45,342 | 0.9 | |
| 34 | 201 | 42,698 | 45,391 | 0.1 | |
| 35 | 201 | 42,660 | 45,285 | 0.3 | 0.3 |
| 36 | 207 | 42,465 | 45,447 | 0.4 | |
| 37 | 201 | 42,686 | 45,615 | 0.1 | |
| 38 | 201 | 42,648 | 45,478 | 0.4 | |
| 39 | 201 | 42,599 | 45,565 | 0.4 | |
| 40 | 201 | 42,561 | 45,429 | 0.1 | |
| 41 | 201 | 42,512 | 45,516 | 0.0 | |
| 42 | 201 | 42,546 | 45,658 | 4.4 | 4.3 |
| 43 | 201 | 42,621 | 45,729 | 2.3 | 2.4 |
| 44 | 175 | 42,063 | 45,031 | 0.1 | |
| 45 | 175 | 42,150 | 45,080 | 0.1 | |
| 46 | 175 | 42,237 | 45,130 | 0.7 | |

9/13/90
DURANGO RADON FLUX SUMMARY DATA

| Sample # | Collected on (Julian Date) | Northing | Easting | pCi/M^2/s | ( QC ) |
|---|---|---|---|---|---|
| 47 | 212 | 42,306 | 45,169 | 0.0 | |
| 48 | 211 | 42,393 | 45,218 | 0.1 | |
| 49 | 211 | 42,480 | 45,268 | 0.4 | |
| 50 | 172 | 41,940 | 45,246 | 0.1 | |
| 51 | 172 | 41,990 | 45,159 | 0.2 | |
| 52 | 175 | 42,039 | 45,072 | 0.2 | |
| 53 | 170 | 41,978 | 45,383 | 0.1 | |
| 54 | 170 | 42,028 | 45,296 | 0.1 | |
| 55 | 170 | 42,077 | 45,209 | 0.1 | 0.1 |
| 56 | 175 | 42,126 | 45,122 | 0.2 | |
| 57 | 170 | 42,065 | 45,432 | 0.1 | |
| 58 | 172 | 42,114 | 45,345 | 0.1 | |
| 59 | 172 | 42,164 | 45,258 | 0.2 | |
| 60 | 175 | 42,213 | 45,171 | 0.0 | |
| 61 | 212 | 42,135 | 45,472 | 0.0 | |
| 62 | 212 | 42,184 | 45,385 | 0.0 | |
| 63 | 212 | 42,233 | 45,298 | 0.1 | |
| 64 | 204 | 42,222 | 45,521 | 0.3 | |
| 65 | 211 | 42,271 | 45,434 | 0.8 | |
| 66 | 211 | 42,320 | 45,347 | 0.3 | |
| 67 | 211 | 42,309 | 45,570 | 0.3 | |
| 68 | 211 | 42,358 | 45,483 | 0.4 | |
| 69 | 211 | 42,407 | 45,396 | 0.4 | |
| 70 | 205 | 41,924 | 46,423 | 0.3 | 0.3 |
| 71 | 205 | 41,993 | 46,262 | 0.1 | |
| 72 | 205 | 42,001 | 46,455 | 0.5 | |
| 73 | 178 | 42,068 | 46,294 | 0.2 | 0.2 |
| 74 | 182 | 42,137 | 46,132 | 0.2 | |
| 75 | 165 | 41,904 | 46,326 | 0.1 | 0.1 |
| 76 | 165 | 41,883 | 46,228 | 0.1 | 0.1 |
| 77 | 154 | 41,863 | 46,130 | 0.1 | |
| 78 | 154 | 41,842 | 46,032 | 0.1 | 0.1 |
| 79 | 165 | 41,972 | 46,164 | 0.0 | 0.0 |
| 80 | 154 | 41,952 | 46,066 | 0.0 | |
| 81 | 168 | 41,931 | 45,968 | 0.1 | |
| 82 | 168 | 41,910 | 45,870 | 0.1 | |
| 83 | 168 | 41,890 | 45,772 | 0.2 | |
| 84 | 154 | 42,040 | 46,002 | 0.1 | |
| 85 | 168 | 42,020 | 45,904 | 0.1 | |
| 86 | 168 | 41,999 | 45,806 | 0.1 | |
| 87 | 178 | 42,101 | 46,510 | 0.1 | |
| 88 | 178 | 42,185 | 46,456 | 0.1 | |
| 89 | 178 | 42,269 | 46,403 | 0.1 | |
| 90 | 178 | 42,354 | 46,349 | 0.1 | |
| 91 | 182 | 42,438 | 46,295 | 0.3 | 0.3 |
| 92 | 183 | 42,523 | 46,242 | 0.0 | |

9/13/90
DURANGO RADON FLUX SUMMARY DATA

| Sample # | Collected on (Julian Date) | Northing | Easting | pCi/M^2/s | ( QC ) |
|---|---|---|---|---|---|
| 93 | 183 | 42,607 | 46,188 | 0.1 | |
| 94 | 194 | 42,691 | 46,134 | 0.1 | |
| 95 | 182 | 42,084 | 46,402 | 0.1 | |
| 96 | 178 | 42,169 | 46,348 | 0.1 | |
| 97 | 178 | 42,253 | 46,294 | 0.0 | |
| 98 | 182 | 42,338 | 46,241 | 0.1 | |
| 99 | 183 | 42,422 | 46,187 | 0.1 | 0.1 |
| 100 | 183 | 42,506 | 46,134 | 0.1 | |
| 101 | 194 | 42,591 | 46,080 | 0.2 | |
| 102 | 194 | 42,675 | 46,026 | 0.1 | |
| 103 | 178 | 42,153 | 46,240 | 0.1 | |
| 104 | 178 | 42,237 | 46,186 | 0.1 | |
| 105 | 182 | 42,322 | 46,133 | 0.1 | |
| 106 | 183 | 42,406 | 46,079 | 0.1 | |
| 107 | 183 | 42,490 | 46,025 | 0.0 | 0.1 |
| 108 | 194 | 42,575 | 45,972 | 0.1 | |
| 109 | 194 | 42,659 | 45,918 | 0.1 | |
| 110 | 182 | 42,221 | 46,078 | 0.1 | |
| 111 | 183 | 42,305 | 46,024 | 0.1 | |
| 112 | 194 | 42,390 | 45,971 | 0.7 | 0.7 |
| 113 | 194 | 42,474 | 45,918 | 1.9 | 1.9 |
| 114 | 194 | 42,558 | 45,864 | 0.2 | |
| 115 | 194 | 42,643 | 45,810 | 0.1 | |
| 116 | 201 | 42,727 | 45,756 | 0.0 | |
| 117 | 175 | 42,103 | 44,939 | 0.2 | 0.1 |
| 118 | 177 | 42,123 | 44,842 | 0.1 | 0.2 |
| 119 | 175 | 42,136 | 45,003 | 0.1 | |
| 120 | 175 | 42,211 | 44,922 | 0.2 | |
| 121 | 175 | 42,224 | 44,838 | 0.1 | |
| 122 | 175 | 42,224 | 44,752 | 0.1 | |
| 123 | 175 | 42,280 | 45,039 | 0.1 | |
| 124 | 175 | 42,309 | 44,944 | 0.1 | |
| 125 | 175 | 42,323 | 44,845 | 0.1 | 0.2 |
| 126 | 175 | 42,323 | 44,745 | 0.2 | |
| 127 | 204 | 42,308 | 44,646 | 0.0 | |
| 128 | 215 | 42,342 | 45,098 | 0.1 | 0.1 |
| 129 | 215 | 42,370 | 45,024 | 0.1 | |
| 130 | 215 | 42,390 | 44,948 | 0.1 | |
| 131 | 215 | 42,401 | 44,870 | 0.3 | |
| 132 | 215 | 42,405 | 44,791 | 0.3 | 0.2 |
| 133 | 215 | 42,433 | 45,138 | 0.2 | |
| 134 | 215 | 42,465 | 45,055 | 0.1 | |
| 135 | 215 | 42,488 | 44,968 | 0.1 | |
| 136 | 215 | 42,501 | 44,880 | 0.0 | |
| 137 | 215 | 42,525 | 45,178 | 0.1 | |
| 138 | 215 | 42,560 | 45,085 | 0.0 | |

9/13/90
DURANGO RADON FLUX SUMMARY DATA

| Sample # | Collected on (Julian Date) | Northing | Easting | pCi/M^2/s | ( QC ) |
|---|---|---|---|---|---|
| 139 | 215 | 42,585 | 44,988 | 0.0 | |
| 140 | 205 | 42,090 | 46,136 | 0.1 | |

9/13/90
DURANGO
RADON FLUX VS. QC RESULTS

| SAMPLE # | Collected on (Julian Date) | NORTHING | EASTING | pCi/M^2/s | ( QC ) |
|---|---|---|---|---|---|
| 1 | 168 | 41,983 | 45,729 | 0.1 | 0.1 |
| 3 | 172 | 42,016 | 45,519 | 0.1 | 0.2 |
| 5 | 204 | 42,085 | 45,559 | 0.8 | 0.8 |
| 12 | 207 | 42,416 | 45,534 | 0.7 | 0.7 |
| 19 | 204 | 42,082 | 45,810 | 1.1 | 1.1 |
| 30 | 201 | 42,451 | 45,719 | 0.0 | 0.0 |
| 35 | 201 | 42,660 | 45,255 | 0.3 | 0.3 |
| 42 | 201 | 42,546 | 45,658 | 4.4 | 4.3 |
| 43 | 201 | 42,621 | 45,729 | 2.3 | 2.4 |
| 47 | 212 | 42,306 | 45,169 | 0.5 | 0.4 |
| 55 | 170 | 42,077 | 45,209 | 0.1 | 0.2 |
| 68 | 211 | 42,358 | 45,483 | 0.3 | 0.3 |
| 70 | 205 | 41,924 | 46,423 | 0.3 | 0.3 |
| 73 | 178 | 42,068 | 46,294 | 0.2 | 0.1 |
| 75 | 165 | 41,904 | 46,326 | 0.1 | 0.1 |
| 76 | 165 | 41,883 | 46,228 | 0.1 | 0.1 |
| 78 | 154 | 41,842 | 46,032 | 0.0 | 0.1 |
| 79 | 165 | 41,972 | 46,164 | 0.1 | 0.1 |
| 91 | 182 | 42,438 | 46,295 | 0.0 | 0.1 |
| 99 | 183 | 42,422 | 46,187 | 0.1 | 0.1 |
| 107 | 183 | 42,490 | 46,025 | 0.0 | 0.0 |
| 112 | 194 | 42,390 | 45,971 | 0.7 | 0.7 |
| 113 | 194 | 42,474 | 45,918 | 1.9 | 1.9 |
| 117 | 175 | 42,107 | 44,939 | 0.2 | 0.2 |
| 118 | 177 | 42,12[illegible] | 44,842 | 0.3 | 0.3 |
| 125 | 175 | 42,323 | 44,845 | 0.1 | 0.1 |
| 128 | 215 | 42,342 | 45,098 | 0.1 | 0.1 |
| 132 | 215 | 42,405 | 44,791 | 0.3 | 0.2 |

Regression Output:

| | |
|---|---|
| Constant | 0.004679 |
| Std Err of Y Est | 0.052671 |
| R Squared | 0.996866 |
| No. of Observations | 28 |
| Degrees of Freedom | 26 |
| X Coefficient(s) | 0.993551 |
| Std Err of Coef. | 0.01[illegible]925 |

CORRELATION COEFFICIENT .99843

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

DOCUMENT NO. MK-F-UMTRA-09
REVISION NO. 0

HEALTH PHYSICS PROCEDURE

RADON FLUX MEASUREMENT

RAC-0.5

APPROVAL

[illegible]

APPROVED: Bill Zebuch for 7/18/90
JAMES G. OLDHAM
REMEDIAL ACTIONS CONTRACTOR, UMTRA PROJECT DIRECTOR

APPROVED: M. Frank Petelka for 7/18/90
M. FRANK PETELKA
REMEDIAL ACTIONS CONTRACTOR, UMTRA PROJECT, HEALTH PHYSICS AND ENVIRONMENT MANAGER

APPROVED: Phil D Cate 7/18/90
PHIL D. CATE
REMEDIAL ACTIONS CONTRACTOR, UMTRA PROJECT, QUALITY MANAGER

APPROVED: Frank B. Bonfiglio for 7/18/90
MARK L. MATTHEWS
U.S. DEPARTMENT OF ENERGY, UMTRA PROJECT, PROJECT MANAGER

APPROVED: Frank B. Bonfiglio for 7/18/90
BETH SELLERS
U.S. DEPARTMENT OF ENERGY, UMTRA PROJECT, ENVIRONMENT, HEALTH AND SAFETY MANAGER

RADON FLUX MEASUREMENTS

RAC-025

1.0 SCOPE

1.1 Purpose

This procedure describes the sampling methodology, analysis, and calculations necessary to measure radon flux using in-situ charcoal canisters.

1.2 Applicability

The requirements of this procedure apply to all radon flux measurements made after placement of radon barrier material at any UMTRA Project site, in accordance with the requirements set forth in 40 CFR 61, Subpart T, for disposal of uranium mill tailings.

2.0 PREREQUISITES

2.1 Instrumentation

An Opposed Crystal System shall be assembled and operated in accordance with requirements in RAC-001 and RAC-015, and shall be available for use in counting the exposed charcoal media.

2.2 Weather Conditions

2.2.1 Flux measurements shall not be made if it is raining or if it has rained more than one-tenth of an inch in the last 24 hours, or if it too wet for construction (as determined by the MK-F Site Manager).

2.2.2 If rainfall occurs during the 24 hour measurement period, the measurement is invalid if the seal around the lip of the canister has washed away or if the canister is surrounded by standing water.

2.2.3 Radon flux measurements shall not be made if the ambient temperature is below 35°F or if the ground is frozen.

2.3 Charcoal Collection Media

2.3.1 Activated charcoal from the same manufacturing batch shall be used for each group of measurements.

2.3.2 Each batch of charcoal used on site shall be kept separate from other batches. Batches shall not be mixed.

2.4 All radon flux measurements shall be made after the final lift of radon barrier material has been placed but prior to placement of any

other layer except for filter layers. No measurements shall be made on intermediate barrier lifts or tailings material.

## 3.0 CANISTER PREPARATION

### 3.1 Activated Charcoal Preparation

3.1.1 The charcoal to be used shall be purged of any radon before being used by heating in an oven for 24 hours at 110°C. Fill an OCS can with charcoal (approximately 400 ml). Fill a minimum of 3 OCS cans for blanks from each batch. (See Section 8.2). Consecutively label OCS cans. Place the cans of charcoal in the oven and record the date, oven temperature, and time in the Radon Flux Measurement Logbook (RFML). After 24 hours, remove the cans of charcoal from the oven and record the date, oven temperature, and time removed from the oven in the RMFL book. The oven temperature should be measured with a thermometer that can read 0-200°C in 1°C increments or by using the oven's built-in temperature indicator.

3.1.2 The charcoal shall then be cooled to room temperature in an area of background radon concentration. Seal the can.

3.1.3 Weigh each can to the nearest 0.1g and record in RFML Book.

### 3.2 Canister Preparation

3.2.1 Prepare each canister in the field immediately prior to placement.

3.2.2 Turn the canister over on its handle and remove the retainer wire and bottom pad.

3.2.3 Open a prepared charcoal can and pour the activated charcoal in the center of the plastic grid. Distribute the charcoal evenly over the grid with your fingers or with a straight-edge.

3.2.4 Place pad, screen side toward the charcoal, on the grid.

3.2.5 Secure the pad in the canister by inserting the retainer wire in the tabs on the inside of the canister.

## 4.0 MEASUREMENT LOCATIONS

### 4.1 Location Establishment

4.1.1 Measurements shall be made on each disposal cell at 100 regularly spaced locations over the entire pile. Each location will be as near the center of an individual measurement region (approximately 1/100 of the pile area) as practical. The MK-Ferguson (MK-F) Site Manager shall identify the proposed sample locations on a Measurement Location Drawing.

4.1.2 The disposal cell surface area shall be determined in units of square meters. Determination of cell surface area shall be performed by MK-F site staff.

4.1.3 A copy of the Measurement Location Drawing will be provided to the Site HP Manager and the RAC EDV Manager prior to taking any measurements. The Drawing must be provided well in advance to allow submittal to the DOE.

4.2 Location Restrictions

4.2.1 No measurement location shall fall within 3 meters of the edge of the barrier or within 3 meters of an intermediate lift, or an exposed tailings surface.

4.2.2 Each measurement location shall be free from large rocks, standing water, and vegetation.

5.0 CANISTER PLACEMENT

5.1 Each charcoal canister shall be placed on a pre-determined location, per section 4.1 , for a period of 22 to 26 hours, and, when possible, canisters should be placed in the morning.

5.2 The location surface shall not be penetrated by the lip of the canister. Each canister shall be carefully positioned on a flat surface using soil to seal around the edge (lip) of the canister. Obtain a bucket of radon barrier material and use it to seal the canister by mounding around its outer edge.

5.3 Each canister shall be identified according to sample number location, charcoal sequential identification number, date and time placed using a soil sample label.

5.4 This canister information shall be recorded in the RFML Book after each placement and shall include; sample and location numbers, charcoal can identification number, the date, time of placement, and weather conditions in the previous 24 hours.

6.0 CANISTER COLLECTION

6.1 After the sample collection time period has elapsed, carefully remove the canister from the measurement location.

6.2 Carefully unload the charcoal from the canister into a large plastic bag. Disassemble the canister completely and recover all visible charcoal. Seal the bag. Label the bag with sample location number, date and time collected. Include this information in the RMFL Book along with a notation regarding weather conditions at the time of collection and during the measurement period.

6.3 Return the measurement location surface to as near its original condition as possible.

6.4 If it is apparent that a canister has been moved, disturbed, or tampered with, that canister measurement shall be deemed invalid, a notation shall be made in the RMFL Book, and the location resampled. If such conditions exist to an extent that indicates damage has occurred to the radon barrier itself, immediately notify the Site H.P. Manager. The Site H.P. Manager shall then notify the MK-F Site Manager.

6.5 Transport the sample bag(s) to the sample preparation area as soon as possible.

## 7.0 CHARCOAL SAMPLE PREPARATION

7.1 The charcoal in the bag(s) shall be transferred to an OCS sample can so that the quantity of radon on the charcoal can be determined. This activity shall be conducted in a clean work area.

7.1.1 Position the plastic bag so that the charcoal collects in one of the bottom corners. Gently tap the side of the bag to unlodge trapped particles.

7.1.2 Once the charcoal is collected in a bag corner, place it in an OCS can and cut away the excess plastic bag. Seal the can. Weigh the can to the nearest 0.1g and record in the RFML Book.

7.1.3 If less than 90% of the original charcoal weight is not recovered, the measurement may be invalid and must be investigated. The EDV Manager will determine if the flux measurement may be weight corrected, or if the measurement must be repeated. The canister should be examined for detects and repaired as necessary.

7.1.4 Label the can with the sample and location number for the canister.

7.1.5 Allow a minimum of 4 hours not to exceed 24 hours after sample collection, for equilibration of radon and its daughters before counting.

## 8.0 CHARCOAL SAMPLE COUNTING

8.1 Charcoal Standards

8.1.1 Daily, prior to counting any charcoal samples, both the 250 pCi/g and 500 pCi/g charcoal standards shall be counted on the OCS, each for 500 seconds. The standards shall be leak tested prior to each use with the results recorded in the RFML book.

The integral data for OCS Region of Interest (ROI) #1 shall be used to calculate the counting efficiency for each of the standards. The average of those efficiencies will be used in the sample calculation.

These standards shall be traceable to the National Institute of Standards and Technology (NIST). Standard count results shall be recorded on the RFML Book.

8.1.2 Both charcoal standards, when counted, should yield results within the 95% confidence interval of their known activities as determined from historical data (Section 10.1). If count results from this functional test are not within these limits for accuracy, sample counts will be suspended until the Instrumentation Manager investigates the cause, corrects the malfunction and subsequently approves use of the system.

8.1.3 Calculate a counting efficiency for each standard by using the following equation:

$$Eff = \frac{(\text{Standard Integral \#1/LT}) - (\text{Blank Integral \#1/LT})}{(\text{Std. pCi/g}) * (\text{g}) * 2.22}$$

Where; LT is Live Time

8.1.4 Record the counting efficiency in the RFML Book.

8.2 Charcoal Blanks

8.2.1 A can of unexposed, oven-dried charcoal prepared in Section 3.1.2 shall be counted on the OCS for 500 seconds.

8.2.2 If the same charcoal batch is used on different days for flux measurements, the same blank may be recounted. If a different charcoal batch is used, the corresponding three batch blanks shall be used.

8.2.3 Record the blank count results in the RFML Book.

8.3 Charcoal Samples

8.3.1 After the standards and blank have been counted, each flux measurement sample shall be counted for 500 seconds.

8.3.2 Both start and end counting times shall be recorded on the RFML Book.

8.3.3 When a sample count has been completed, record the integral counts under ROI #1 in the RFML Book. Determine the net counts for that sample by subtracting the background ROI #1 integral from the sample ROI #1 integral, record this value in the RFML Book.

8.3.4 When sample counting is completed, including duplicate counting (10.2), empty all used cans into a container labelled with the appropriate manufacturing batch number.

## 9.0 RADON FLUX CALCULATIONS

Once the net counts are obtained (8.3.3) the following calculation in 9.1 shall be used to determine the radon flux.

9.1 Individual Region Flux Measurements

$$J = \frac{C\lambda^2}{AEK\left[(1 - e^{-\lambda t_1})\left(e^{-\lambda(t_2 - t_1)} - e^{-\lambda(t_3 - t_1)}\right)\right]}$$

Where:

J = Radon flux (pCi/$m^2$/sec)
C = Net counts in ROI #1
A = Area of the canister, 0.05 $m^2$
E = OCS efficiency (cpm/dpm)
K = conversion from dps to pCi (0.037 dps/pCi)
$\lambda$ = Radon decay constant 2.097 E - 6/sec
$t_1$ = Exposure time (in seconds)
$t_2$ = Time from canister placement (start of measurement) to start of counting (in seconds)
$t_3$ = Time from canister placement (start of measurement) to end of counting (in seconds)

Record the result in the RFML Book.

9.2 Mean Radon Flux

The mean radon flux for the total cell or pile area shall be calculated as follows:

$$J_X = \frac{J_1 A_1 + \ldots J_{100} A_{100}}{A_X}$$

Where:

$J_X$ = Mean radon flux (pCi/$m^2$/sec)
$J_1$ = Radon flux measurement in region 1 (pCi/$m^2$/sec)
$A_1$ = Area of region 1 ($m^2$)
$A_X$ = Total Cell Area ($m^2$)

9.3 All results shall be recorded in the RFML Book to one decimal point.

## 10.0 QUALITY CONTROL CHECKS

10.1 Prior to initiating this procedure at any site, both charcoal standards shall be counted twenty (20) times each to establish the 95% confidence levels.

10.2 Ten (10) percent, or a minimum of one per measurement group, of flux measurement samples shall be recounted to document the reproducibility of the counting technique.

10.3 At least 85% of all measurements must yield useable results.

10.4 A precision of 10% of the mean must be maintained for all samples above 1.0 $pCi/m^2s$.

10.5 The accuracy of all measurements must be plus or minus 10%.

10.6 All flux measurement calculations shall be verified and reviewed by the Site H.P Supervisor and approved by the Site H.P. Manager. Approval will be noted by signature.

11.0 ACTION LEVELS

The EDV Manager, Albuquerque, shall be notified when any single radon flux measurement result exceeds 10.0 $pCi/m^2/sec$, or if any other criterion in Section 10 is not met.

12.0 RECORDS AND REPORTS

12.1 All flux measurement documentation shall be reviewed and signed by the Site H.P. Manager.

12.2 A copy of the Radon Flux Measurement Logbook shall transmitted to the EDV Manager when each group of measurements has been completed. The original site Flux Measurement Location Drawing and RFML Book shall be transmitted to the EDV Manager when all measurements have been completed.