ATLAS MINERALS
CORRECTIVE ACTION PLAN
RADON EMISSION PREDICTION

AUGUST, 1989

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By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 1 OF 4

Chkd. by: [illegible] Date: 8-16-89 Proj. No. 88-06

CORRECTIVE ACTION PLAN RADON CONCENTRATION PREDICTION CALCULATIONS
INDRODUCTION

PURPOSE:
THE PURPOSE OF THESE CALCULATIONS IS TO DETERMINE THE IMPACT ON THE RADON-222 CONCENTRATIONS IN AIR ONCE THE ATLAS MINERALS FACILITY UNDERGOES THE CORRECTIVE ACTION PI PROPOSED BY ATLAS. AS REQUESTED BY THE NUCLEAR REQULATORY COMMISSION, THESE CALCULATIONS SHOW THAT THE CORRECTIVE ACTION PLAN CAN BE EXPECTED TO LOWER RADON CONCENTRATIONS BELOW REGULATORY LIMIT OF 30 E-10 uCi/ml.

METHODOLOGY:
A GAUSSIAN ATMOSPHERIC DISPERSION EQUATION WAS USED TO MODEL THE RADON GAS DISPERSION IN AIR. THE RADON GAS IS ASSUMED TO ACT AS A CONTAMINATED GASEOUS PLUME ORIGINATING FROM A POINT SOURCE WITH THE DEGREE OF DILUTION DEPENDENT UPON ATMOSPHERIC CONDITIONS SUCH AS WIND SPEED, DIRECTION, AND SOLAR RADIATION. TO DETERMINE THE AMOUNT OF RADON BEING EMITTED FROM A POINT, THE RADON EXIT FLUX WAS MULTIPLIED BY THE AREA OF THE RADON SOURCE TO GENERATE A RADON "PRODUCTION" TERM . THE EMISSION OF RADON IS ASSUMED TO TAKE PLACE OVER THE ENTIRE SURFACE OF THE SOURCE AREA. THE POINT SOURCE WAS THEN LOCATED NEAR THE CENTER OF THE AREA GENERATING THE RADON TO DETERMINE THE DISTANCE DOWNWIND TO THE NEAREST AIR SAMPLING LOCATION.

PROCEDURE:
THE FLUX FOR THE RADON SOURCES; EACH ORE PILE, THE WINDBLOWN TAILINGS STOCKPILE, AND IMPOUNDED COARSE TAILINGS SHOWN ON SHEET 29 OF 42 WAS DETERMINED. USING THE "RADON" COMPUTER CODE (USNRC REGULATORY GUIDE NO. 3.64, APRIL 1988). THE RADON "PRODUCTION" WAS DETERMINED FOR EACH SOURCE AREA PRIOR TO AND AFTER THE CORRECTIVE ACTION PLAN. THE RESULTS ARE SUMMARIZED ON SHEET 3 OF 42 AND ARE FOLLOWED BY THE "RADON" OUTPUT.

THE RADON CONCENTRATIONS WERE THEN DETERMINED AT AIR SAMPLERS S-1, S-2 AND S-3 USING THE GAUSSIAN MODEL MENTIONED ABOVE PRIOR TO AND AFTER THE CORRECTIVE ACTION PLAN. THE MODEL WAS CALIBRATED TO MATCH CLOSELY EXISTING CONDITIONS USING THE AVERAGE OF THE REPORTED 1988 QUARTELY CONCENTRATIONS AT EACH OF THE THREE AIR SAMPLING LOCATIONS. THE MODEL WAS THEN USED TO PREDICT THE RADON CONCENTRATIONS AT THE AIR SAMPLERS BASED ON THE THE PRODUCTION VALUES AND LOCATION OF THE ORE AND WINDBLOWN TAILINGS AFTER THE CORRECTIVE ACTION PLAN. THE GAUSSIAN MODEL RESULTS ARE SHOWN BELOW. THE LOCATION OF AIR SAMPLERS S-1, S-2, AND S-3 ARE SHOWN ON FIGURE 2 SHEET 30 OF 42.

RESULTS:

AIR SAMPLER	*1988 AVERAGE CONCENTRATIONS uCi/ml	CALCULATED 1988 AVERAGE CONCENTRATIONS uCi/ml	PREDICTED CONCENTRATIONS FOLLOWING CORRECTIVE ACTION PLAN uCi/ml
AIR SAMPLER S-1	49 E-10	45 E-10	1.1 E-10
AIR SAMPLER S-2	71 E-10	70 E-10	3.8 E-10
AIR SAMPLER S-3	22 E-10	21 E-10	19.4 E-10

* BASED ON REPORTED 1988 QUARTERLY CONCENTRATIONS

THIS ANALYIS SHOWS THAT RADON CONCENTRATIONS AT THE 3 AIR SAMPLING LOCATIONS SHOULD BE LOWERED TO MEET NRC RADON CONCENTRATION LIMITS BY PLACING ORE AND WINDBLOWN TAILINGS ON TOP OF THE TAILINGS IMPOUNDMENT BETWEEN THE INNER ACCESS ROAD AND CREST OF THE IMPOUNDMENT.

REFERENCES:

1. Vesilind A., Peirce J., "Environmental Engineering",1982
2. U.S. Nuclear Regulatory Research, Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers", April 1988
3. Canonie, "Response to Comments" Prepared for Atlas Minerals, Jan,1989

RADON PRODUCTION CALCULATIONS

SURFACE AREAS OF RADON SOURCES:

EXISTING:
NORTHEAST ORE PILES - 3.8 ACRES
NORTHWEST ORE PILES - 1.6
SOUTH ORE PILES - 1.0
WINDBLOWN TAILINGS - 2.4
COARSE TAILINGS - 43.5
* FINE TAILINGS - 40

POST - CORRECTIVE ACTION PLAN:
NORTHEAST ORE PILES - 0
WEST ORE PILES - 0
SOUTH ORE PILES - 0
WINDBLOWN TAILINGS - 0
COVER AREA - 43.5
*FINE TAILINGS - 40

* RADON EMISSIONS WILL BE CONTINUED TO BE SUPPRESSED BY WATER STORAGE AND EVAPORATIVE DISPOSAL OVER THE TAILINGS SURFACE AND THEREFORE ASSUMED NOT TO CONTRIBUTE TO RADON AIR CONCENTRATIONS.

RADON PRODUCTION PRIOR TO CORRECTIVE ACTION PLAN:

BASED ON THE FLUX AND AREA FOR EACH RADON SOURCE, A PRODUCTION TERM IS CALCULATED. THE FLUX FOR EACH CONDITION IS CALCULATED USING THE RADON COMPUTER MODEL (USNRC REGULATORY GUIDE NO. 3.64, APRIL 1988). THE FOLLOWING SHEETS CONTAIN THE "RADON" OUTPUT.

GOVERNING EQUATION: AREA X FLUX = RADON PRODUCTION

LOCATION	* FLUX pCi/m^2sec	AREA ACRES	CONVERSION FACTOR	PRODUCTION pCi/sec
NORTHEAST ORE	308	3.8	4046.85	4.74E+06
NORTHWEST ORE	308	1.6	4046.85	1.99E+06
SOUTH ORE	308	1.0	4046.85	1.25E+06
WINDBLOWN TAILS	12.4	2.4	4046.85	1.20E+05
COARSE TAILINGS	32	43.5	4046.85	5.63E+06

* SEE FOLLOWING SHEETS FOR FLUX CALCULATION

TOTAL RADON PRODUCTION = 1.37E+07

RADON PRODUCTION POST CORRECTIVE ACTION:

LOCATION	*FLUX pCi/m^2sec	AREA ACRES	CONVERSION FACTOR	PRODUCTION pCi/sec
NORTHEAST ORE	308	0.0	4046.85	0.00E+00
NORTHWEST ORE	308	0.0	4046.85	0.00E+00
SOUTH ORE	308	0.0	4046.85	0.00E+00
WINDBLOWN TAILS	12.4	0.0	4046.85	0.00E+00
COVER AREA	59	43.5	4046.85	1.04E+07

* SEE FOLLOWING SHEETS FOR FLUX CALCULATION

TOTAL RADON PRODUCTION = 1.04E+07

NOTE: PLACING THE ORE ON THE SURFACE OF THE IMPOUNDMENT WILL PREVENT WINDBLOWN TAILINGS. AS A CONSERVATIVE ASSUMPTION, THIS WAS NOT CONSIDERED TO ATTENUATE RADON EMMISSIONS.
A COMPACT SURFACE WILL BE ACHIEVED BY ADDING WATER TO THE ORE FILL REDUCING RADON EMMISSIONS. THIS IS ALSO NEGLECTED IN THIS CALCULATION AS A CONSERVATIVE ASSUMPTION.

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By _____ Date _____ Subject _____ Sheet No. 5 of 42

Chkd. By _____ Date _____ Proj. No. _____

1/4 X 1/4

RADON FLUX CALCULATIONS

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By EJS Date 5/5/89 Subject [illegible] Sheet No. 6 of 42

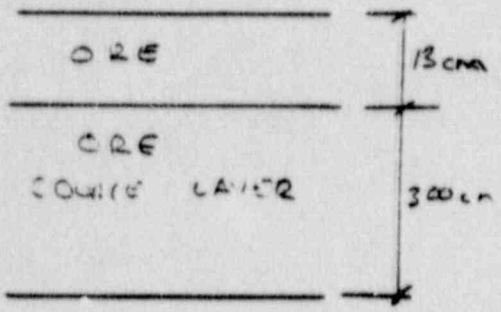
Chkd. By [illegible] Date 5-16-89 [illegible] Proj. No. [illegible]

1/4 X 1/4

RADON FLUX

EXISTING ORE PILES:

THE ORE PILES WERE ASSUMED TO BE AN AVERAGE OF 12 FEET THICK. A RADIOCHEMICAL ANALYSIS RESULT OF A UNIFORM ORE SAMPLE, SHOWN ON SHEET 21 OF 22, WAS USED FOR THE "RADON" INPUT PARAMETERS. A CROSS SECTION IS SHOWN BELOW. THE "RADON" OUTPUT IS ON THE FOLLOWING SHEET. A CROSS SECTION IS SHOWN BELOW THE RADON OUTPUT FOLLOWS



INPUT PARAMETERS (RADON)

POROSITY = 0.41
DENSITY = 1.61 g/cm³
MOISTURE = 6.6 %
DIFFUSION COEF = 0.039 cm²/sec

RADIUM = 269 pCi/gram
EMANATION COEFFICIENT = 0.25

EQUATION Q = RS · E1/n

= (269 pCi/gram)(1.61 g/cm²)(0.25)(2.1×10⁻⁶/cm)/0.41

= 0.000555 pCi/cm²/sec

-----*****! RADON !*****-----

Version 1 - April 1, 1986 - G.F. Birchard tel.# (301) 492-7000
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RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

EXISTING ORE PILES PRIOR TO CORRECTIVE ACTION PLAN

CONSTANTS

RADON DECAY CONSTANT	.0000021	1/s
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	g/cm^3

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	2	
NO LIMIT ON RADON FLUX		
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi/l
RADON FLUX INTO LAYER 1	0	pCi*m^-2/s
SURFACE FLUX PRECISION	.02	pCi*m^-2/s

LAYER INPUT PARAMETERS

LAYER 1

LAYER THICKNESS	300	cm
LAYER POROSITY	.41	
MEASURED LAYER DENSITY	1.61	g/cm^3
MEASURED LAYER SOURCE TERM	.000555	pCi*cm^-3/s
LAYER WEIGHT % MOISTURE	6.6	%
MOISTURE SATURATION FRACTION	.259	
MEASURED LAYER DIFFUSION COEFFICIENT	.039	cm^2/s

LAYER 2

LAYER THICKNESS	13	cm
LAYER POROSITY	.41	
MEASURED LAYER DENSITY	1.61	g/cm^3
MEASURED LAYER SOURCE TERM	.000555	pCi*cm^-3/s
LAYER WEIGHT % MOISTURE	~~1.61~~ 6.6	%
MOISTURE SATURATION FRACTION	.063	
MEASURED LAYER DIFFUSION COEFFICIENT	.039	cm^2/s

← TYPO
FIGURE BY 4 & 5.
ANOTHER RADON
RUN USING 6.6%
SHOWED NO
THERE
WAS

BASE SOURCE FLUX FROM LAYER 1: 3.026D+02 pCi*cm^-3/s

8/42

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m^2/s)	EXIT CONC. (pCi/l)
1	3.000D+02	2.794D+02	2.022D+04
2	1.300D+01	3.077D+02	0.000D+00

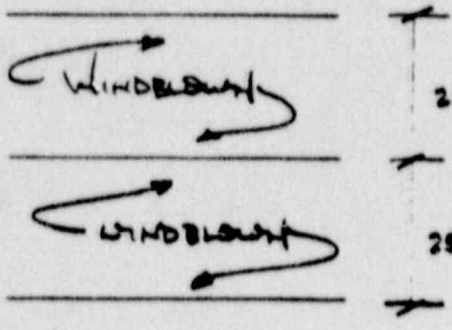
308 pCi/m²/sec

RADON FLUX
CONT

WINDBLOWN TAILINGS IN N'W VALLEY:

WINDBLOWN TAILINGS ARE DRIFTED IN THE VALLEY NW OF THE TAILINGS IMPOUNDMENT. THE THICKNESS OF THE WINDBLOWN TAILINGS "DUNES" IS APPROXIMATED BY AN INFINITE VALUE OF 500 cm. ALL RADIOLOGICAL PROPERTIES OF THE WINDBLOWN TAILS ARE ASSUMED TO BE SIMILAR TO THE "AFFECTED SOILS" PROPERTIES.

THE "RADON" MODEL CROSS-SECTION IS SHOWN BELOW AND THE OUTPUT IS ON THE FOLLOWING TWO PAGES



INPUT PARAMETERS

- SEE "RESPONSE TO NRC COMMENTS, RECLAMATION PLAN URANIUM MILL AND TAILINGS DISPOSAL AREA, JAN. 1989"

SOURCE TERM

$Q = R \cdot S \cdot E \cdot \lambda / \eta$

$= (17)(1.82)(0.29)(2.1\times10^{-6})/0.33$

$= 5.7\times10^{-5}$ pCi/cm³/sec.

POROSITY: 0.33 DENSITY: 1.82 g/cm³
MOISTURE: 8.8% DIFFUSION: 0.009 l/cm
RADIUM: 17 pCi/gm
EMANATION COEFFICIENT = 0.29

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RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS ARE CALCULATED FOR MULTIPLE LAYERS

WINDBLOWN TAILINGS

CONSTANTS

RADON DECAY CONSTANT	.0000021	1/s
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	g/cm^3

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	2	
NO LIMIT ON RADON FLUX		
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi/l
RADON FLUX INTO LAYER 1	0	pCi*m^-2/s
SURFACE FLUX PRECISION	.02	pCi*m^-2/s

LAYER INPUT PARAMETERS

LAYER 1

LAYER THICKNESS	250	cm
LAYER POROSITY	.33	
MEASURED LAYER DENSITY	1.82	g/cm^3
MEASURED LAYER SOURCE TERM	.000057	pCi*cm^-3/s
LAYER WEIGHT % MOISTURE	8.8	%
MOISTURE SATURATION FRACTION	.485	
MEASURED LAYER DIFFUSION COEFFICIENT	.0091	cm^2/s

LAYER 2

LAYER THICKNESS	250	cm
LAYER POROSITY	.33	
MEASURED LAYER DENSITY	1.82	g/cm^3
MEASURED LAYER SOURCE TERM	.000057	pCi*cm^-3/s
LAYER WEIGHT % MOISTURE	8.8	%
MOISTURE SATURATION FRACTION	.485	
MEASURED LAYER DIFFUSION COEFFICIENT	.0091	cm^2/s

BARE SOURCE FLUX FROM LAYER 1: 1.237D+01 pCi*cm^-3/s

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RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m^2/s)	EXIT CONC. (pCi/l)
1	2.500D+02	2.775D-01	2.653D+04
2	2.500D+02	1.238D+01	0.000D+00

12.4 pCi/m²/sec

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By DEC Date 8/8/89 Subject RADON CALCULATION Sheet No. 12 of 12

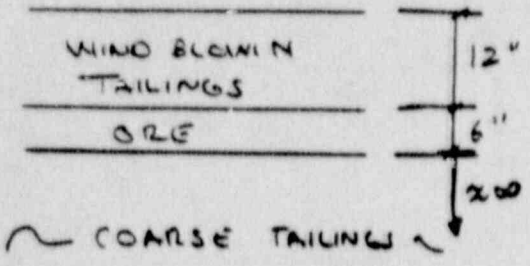
Chkd. By [illegible] Date 8-16-89 SECTION Proj. No. 66-[illegible]

1/4 X 1/4

RADON FLUX
CON'T

CORRECTIVE ACTION PLAN COVER:

THE ORE PILES WILL BE PLACED APPROXIMATELY SIX FEET THICK ON THE TAILINGS IMPOUNDMENT BETWEEN THE CREST AND INTERIOR ACCESS ROAD. ABOVE THAT WILL BE APPROXIMATELY 12 INCHES OF WIND BLOWN TAILINGS. THE WIND BLOWN TAILINGS WERE ASSUMED TO HAVE THE SAME RADIOLOGICAL PROPERTIES AS THE AFFECTED SOIL USED IN THE RECLAMATION PLAN. THE SAME PARAMETERS USED FOR EXISTING ORE WAS USED FOR THE ONE PLACED ON THE IMPOUNDMENT. A CROSS SECTION IS SHOWN BELOW. THE COVER THICKNESS WAS ASSUMED TO BE THE MAXIMUM FOR RADON OF 16.4 FEET (500 cm)



REF: LETTER TO NRC FROM ATLAS MINERALS JULY 19, 1989

TABLE 2

RAECOM INPUT PARAMETERS
(RESPONSE TO COMMENTS)

Material	Radium Concentration (pCi/gm)	Emanation Fraction	Long-Term Moisture Percentage	Diffusion Coefficient (cm^2/s)	Porosity	Dry Density (pcf)	Source Term ($pCi/cm^3/s$)
Coarse Tailings	244	0.17	8.1	3.2×10^{-2}	0.50	83.6	2.33×10^{-4}
Affected Soils	17.0	0.29	8.8	9.1×10^{-3}	0.33	113.6	5.7×10^{-5}

-----*****| RADON |*****-----

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12/42

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

POST CORRECTIVE ACTION PLAN

CONSTANTS

RADON DECAY CONSTANT	.0000021	1/s
RADON WATER/AIR PARTITION COEFFICIENT	.26	
SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	g/cm^3

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	3	
NO LIMIT ON RADON FLUX		
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi/l
RADON FLUX INTO LAYER 1	0	pCi*m^-2/s
SURFACE FLUX PRECISION	.02	pCi*m^-2/s

LAYER INPUT PARAMETERS

LAYER 1

LAYER THICKNESS	500	cm
LAYER POROSITY	.5	
MEASURED LAYER DENSITY	1.34	g/cm^3
MEASURED LAYER SOURCE TERM	.000233	pCi*cm^-3/s
LAYER WEIGHT % MOISTURE	8.1	%
MOISTURE SATURATION FRACTION	.217	
MEASURED LAYER DIFFUSION COEFFICIENT	.032	cm^2/s

LAYER 2

LAYER THICKNESS	15	cm
LAYER POROSITY	.41	
MEASURED LAYER DENSITY	1.61	g/cm^3
MEASURED LAYER SOURCE TERM	.000555	pCi*cm^-3/s
LAYER WEIGHT % MOISTURE	6.6	%
MOISTURE SATURATION FRACTION	.259	
MEASURED LAYER DIFFUSION COEFFICIENT	.039	cm^2/s

LAYER 3

LAYER THICKNESS	31	cm
LAYER POROSITY	.33	
MEASURED LAYER DENSITY	1.82	g/cm^3
MEASURED LAYER SOURCE TERM	.000057	pCi*cm^-3/s
LAYER WEIGHT % MOISTURE	8.8	%
MOISTURE SATURATION FRACTION	.485	
MEASURED LAYER DIFFUSION COEFFICIENT	.0091	cm^2/s

14 #2

BARE SOURCE FLUX FROM LAYER 1: 1.437D+02 pCi*cm^-3/s

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m^2/s)	EXIT CONC. (pCi/l)
1	5.000D+02	3.564D+01	8.344D+04
2	1.500D+01	5.966D+01	7.587D+04
3	3.100D+01	5.904D+01	0.000D+00

59 pCi/m²/sec

8/4/89

Rogers & Associates Engineering Corporation

15/42

REPORT OF RADIUM AND EMANATION COEFFICIENT MEASUREMENTS
(LAB PROCEDURE RAE-SOAP-3.1)

REPORT DATE Feb. 27, 1989

CONTRACT C8900/7

BY RYB

SAMPLE IDENTIFICATION Atlas Minerals

SUBMITTED BY RYB DATE RECEIVED

SAMPLE NUMBER	MOISTURE (DRY WT. %)	RADON EMANATION COEFFICIENT [a]	RADIUM [a] (pCi/gram)	COMMENTS
Atlas Minerals	6.6	0.25 ± 0.01	269 ± 2	

[a] UNCERTAINTIES BASED ON GAMMA-RAY COUNTING STATISTICS ONLY.

RAE

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REPORT OF RADON DIFFUSION COEFFICIENT MEASUREMENTS (TIME-DEPENDENT DIFFUSION TEST METHOD RAE-SOAP-3.6)

REPORT DATE Feb. 27, 1989

CONTRACT C8900/7

BY RYB

SAMPLE IDENTIFICATION Atlas Minerals

SUBMITTED BY RYB DATE RECEIVED

SAMPLE NUMBER	MOISTURE (DRY WT.%)	DENSITY (g/cm^3)	RADON DIFFUSION COEFF. (cm^2/s)	SATURATION[a] (Mp/P)	COMMENTS
Atlas Minerals	5.8	1.61	3.9 E-02	0.23	0.41
		100.5 pcf			

[a] BASED ON A SPECIFIC GRAVITY OF 2.7 (Assumed) g/cm^3.

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By CEC Date 6/8/89 Subject RADON CONCENTRATION Sheet No. 17 of 42

Chkd. By [illegible] Date 6/14/89 PREDICTION Proj. No. 2067

1/4 X 1/4

CALCULATED 1986 AVERAGE CONCENTRATIONS

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTIOW Sheet: 12 OF 4

Chkd. by: Date: Proj. No. 88-067

RADON ATMOSPHERIC DISPERSION

INT OF INTEREST: AIR SAMPLER S-1 EXISTING CONDITIONS
URCE: NORTHEAST ORE PILES PRIOR TO CORRECTIVE ACTION PLAN

USSIAN DISPERSION EQUATION:

EQ. 1 | EQ. 2 | EQ.3

= Q/(2pie*u*oy*oz)(EXP(-.5(Y/oy)^2)*(EXP(-.5(Z-H)^2/oz^2)+(EXP(-.5*(Z+H)^2/oz^2)
ERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

S-1 1988 AVERAGE: 4.9 X E-9 uCi/m
BASED ON REPORTED 1988 QUARTELY
CONCENTRATIONS SHEET 40 R

INPUT PARAMETERS:			RESULTS:	
Q - PRODUCTION RATE (pCi/sec) SHEET 3		4.74E+06	EQ. 1 =	2.95E+03 pCi/m^3
u - AVERAGE WIND SPEED (mph)(m/sec) SHEET 39	2	0.894	EQ. 2 =	1.00E+00
oy - STAND DEVIATION OF Y DISP.		22	EQ. 3 =	1.66E+00
oz - STAND DEVIATION OF Z DISP.		13		
- DOWNWIND DISTANCE (ft)(m) FIG. 2	450	137.16	(1X2X3)*1E-12 =	4.88E-09 uCi/ml
- HORIZONTAL CROSS WIND DIST (ft)(m)	0	0		
- HEIGHT OF POINT OF INTEREST (m)		3		
- HEIGHT OF SOURCE (ft)(m) (ESTIMATED)	25	7.62	X =	4.88E-09 uCi/ml

SUMPTIONS:
UNIFORM, STEADY AND UNIDIRECTIONAL WIND
oy AND oz BASED ON MODERATE SOLAR RADIATION (SEE SHEET 34 OF 42) CONDITION "B"
PREVAILING WIND DIRECTION FROM THE WEST-SOUTHWEST. MOST CRITICAL CONDITION (REF. SAFETY ANALYSIS
NORTHEAST ORE PILES MAJOR RADON SOURCE FOR AIR SAMPLER S-1
AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
WIND SPEED OCCURED % OF DATA COLLECTION PERIOD (REF: SAFETY ANALYSIS REPORT 1975) ASSUMED CAL
SHEET 39 < 2.7% TO REACH HIGH
RADON

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 19 OF 4

Chkd. by: [illegible] Date: [illegible] Proj. No. 88-067

RADON ATMOSPHERIC DISPERSION

POINT OF INTEREST: AIR SAMPLER S-2 EXISTING CONDITIONS
SOURCE: TAILINGS IMPOUNDMENT PRIOR TO CORRECTIVE ACTION PLAN

GAUSSIAN DISPERSION EQUATION:

EQ. 1 | EQ. 2 | EQ.3

= Q/(2pie*u*oy*oz)(EXP(-.5(Y/oy)^2)*(EXP(-.5(Z-H)^2/oz^2)+(EXP(-.5*(Z+H)^2/oz^2)

WHERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

INPUT PARAMETERS:			RESULTS:		
Q - PRODUCTION RATE (pCi/sec) SHEET 3		5.60E+06	EQ. 1 =	8.75E+02	pCi/m^3
u - AVERAGE WIND SPEED (mph)(m/sec) SHEET 39 2		0.894	EQ. 2 =	1.00E+00	
oy - STAND DEVIATION OF Y DISP.		38	EQ. 3 =	1.19E+00	
oz - STAND DEVIATION OF Z DISP.		30			
X - DOWNWIND DISTANCE (ft)(m) FIG. 2	700	213.36	(1X2X3)/1E-12 =	1.04E-09	uCi/ml
Y - HORIZONTAL CROSS WIND DIST(ft)(m)	0	0			
Z - HEIGHT OF POINT OF INTEREST (m)		3			
H - HEIGHT OF SOURCE (ft)(m) TECHNICAL SPECIFICATION CANONIE, 1989	100	30.48	X =	1.04E-09	uCi/ml

ASSUMPTIONS:

. UNIFORM, STEADY AND UNIDIRECTIONAL WIND
. oy AND oz BASED ON MODERATE SOLAR RADIATION (SEE SHEET 24 OF 42) CONDITION "B"
. PREVAILING WIND DIRECTION FROM THE WEST-SOUTHWEST MOST CRITICAL CONDITION (REF. SAFETY ANALYSIS REPORT, 1975)
. SOUTH AND NORTHWEST ORE PILES AND TAILINGS IMPOUNDMENT MAJOR RADON SOURCE FOR AIR SAMPLER S-2. THE RESULTS ARE ADDED TOGETHER ON SHEET 21
. AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
. WIND SPEED OCCURED 5% OF DATA COLLECTION PERIOD (REF: SAFETY ANALYSIS REPORT 1975) SHEET 39 2

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 20 OF :

Chkd. by: Date: Proj. No. 88-06

RADON ATMOSPHERIC DISPERSION

POINT OF INTEREST: AIR SAMPLER S-?
SOURCE: SOUTH ORE PILES

EXISTING CONDITIONS
PRIOR TO CORRECTIVE ACTION PLAN

GAUSSIAN DISPERSION EQUATION:

EQ. 1	EQ. 2	EQ.3

$$X = Q/(2\pi e^{*}u^{*}oy^{*}oz)(EXP(-.5(Y/oy)^2)^{*}(EXP(-.5(Z-H)^2/oz^2)+(EXP(-.5^{*}(Z+H)^2/oz^2)$$

WHERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

INPUT PARAMETERS:			RESULTS:		
Q - PRODUCTION RATE (pCi/sec) SHEET 3		1.20E+06	EQ. 1 =	8.90E+02	pCi/m^3
u - AVERAGE WIND SPEED (mph)(m/sec) SHEET 39 2		0.894	EQ. 2 =	1.00E+00	
oy - STAND DEVIATION OF Y DISP.		20	EQ. 3 =	1.88E+00	
oz - STAND DEVIATION OF Z DISP.		12			
X - DOWNWIND DISTANCE (ft)(m) FIG. 2	400	121.92	(1X2X3)/1E-12 =	1.67E-09	uCi/ml
Y - HORIZONTAL CROSS WIND DIST(ft)(m)	0	0			
Z - HEIGHT OF POINT OF INTEREST (m)		3			
H - HEIGHT OF SOURCE (ft)(m) ESTIMATED	10	3.048	X =	1.67E-09	uCi/ml

ASSUMPTIONS:

1. UNIFORM, STEADY AND UNIDIRECTIONAL WIND
2. oy AND oz BASED ON MODERATE SOLAR RADIATION (SEE SHEET 34 OF 42)CONDITION "B"
3. PREVAILING WIND DIRECTION FROM THE WEST-SOUTHWEST MOST CRITICAL CONDITION (REF. SAFTETY ANALYSIS REPORT, 1975)
4. SOUTH AND NORTHWEST ORE PILES AND TAILINGS IMPOUNDMENT MAJOR RADON SOURCE FOR AIR SAMPLER S-2. THE RESULTS ARE ADDED TOGETHER ON SHEET 21
5. AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
6. WIND SPEED OCCURED 5% OF DATA COLLECTION PERIOD (REF: SAFETY ANALYSIS REPORT 1975)

SHEET 39

y: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 21 OF 42

hkd. by: Date: 8/10/89 Proj. No. 88-067

RADON ATMOSPHERIC DISPERSION

N. OF INTEREST: AIR SAMPLER S-2
RCE: NORTHWEST ORE PILES

EXISTING CONDITIONS
PRIOR TO CORRECTIVE ACTION PLAN

SSIAN DISPERSION EQUATION:

EQ. 1 | EQ. 2 | EQ.3

$$Q/(2\pi\sigma_y\sigma_z)(\exp(-.5(Y/\sigma_y)^2)*(\exp(-.5(Z-H)^2/\sigma_z^2)+(\exp(-.5*(Z+H)^2/\sigma_z^2)$$

RE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

AIR SAMPLER S-3 1988 AVERAGE: 7.2 E-9 uCi/ml
BASED ON REPORTED 1988 QUARTERLY
CONCENTRATIONS: SHEET 41

NPUT PARAMETERS:

			RESULTS:	
- PRODUCTION RATE (pCi/sec) SHEET 3		1.20E+06	EQ. 1 =	2.[illegible]E-03 pCi/m^3
- AVERAGE WIND SPEED (mph)(m/sec)	0.12	0.05364	EQ. 2 =	1.00E+00
- STAND DEVIATION OF Y DISP.		54	EQ. 3 =	1.98E+00
- STAND DEVIATION OF Z DISP.		30		
- DOWNWIND DISTANCE (ft)(m) FIG. 2	1000	304.8	(1X2X3)/1E-12 =	4.35E-09 uCi/ml
- HORIZONTAL CROSS WIND DIST(ft)(m)	0	0		
- HIEGHT OF POINT OF INTEREST (m)		3		
- HIEGHT OF SOURCE (ft)(m) ESTIMATED	10	3.048	X =	4.35E-09 uCi/ml

OTAL RADON CONCENTRATION FOR S-2 = 1.04 E-9 uCi/ml + 1.67 E-9 uCi/ml + 4.35 E -9 uCi/ml = 7.06 E-9

(TAILINGS) SHEET 19 (SOUTH ORE) SHEET 20

UMPTIONS:
UNIFORM, STEADY AND UNIDIRECTIONAL WIND
σ_y AND σ_z BASED ON MODERATE SOLAR RADIATION (SHEET 34 & 36 OF 42)CONDITION "B"
PREVAILING WIND DIRECTION FROM THE WEST-NORTHWEST MOST CRITICAL. ASSUMED CALM CONDITIONS
CONDITION (REF. SAFETY ANALYSIS REPORT, 1975) SEE SHEET 39
SOUTH AND NORTHWEST ORE PILES AND TAILINGS IMPOUNDMENT MAJOR RADON SOURCE
AIR SAMPLER S-2
AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 22 OF 42

Chkd. by: [illegible] Date: 8/10/89 Proj. No. 87-687-

RADON ATMOSPHERIC DISPERSION

POINT OF INTEREST: AIR SAMPLER S-3
SOURCE: WINDBLOWN TAILINGS

EXISTING CONDITIONS
PRIOR TO CORRECTIVE ACTION PLAN

GAUSSIAN DISPERSION EQUATION:

EQ. 1	EQ. 2	EQ.3

$$X = Q/(2\pi u\,\sigma_y\,\sigma_z)(EXP(-.5(Y/\sigma_y)^2)*(EXP(-.5(Z-H)^2/\sigma_z^2)+(EXP(-.5*(Z+H)^2/\sigma_z^2)$$

WHERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

INPUT PARAMETERS:			RESULTS:	
Q - PRODUCTION RATE (pCi/sec) SHEET 3		1.20E+05	EQ. 1 =	5.39E+02 pCi/m^3
u - AVERAGE WIND SPEED (mph)(m/sec)	0.09	0.04023	EQ. 2 =	1.00E+00
oy - STAND DEVIATION OF Y DISP.		40	EQ. 3 =	1.91E+00
oz - STAND DEVIATION OF Z DISP.		22		
X - DOWNWIND DISTANCE (ft)(m) FIG. 2	700	213.36	(1X2X3)/1E-12 =	1.03E-09 uCi/ml
Y - HORIZONTAL CROSS WIND DIST (m)	0	0		
Z - HEIGHT OF POINT OF INTEREST (m)		3		
H - HEIGHT OF SOURCE (ft)(m) ESTIMATED	20	6.096	X =	1.03E-09 uCi/ml

ASSUMPTIONS:

1. UNIFORM, STEADY AND UNIDIRECTIONAL WIND
2. oy AND oz BASED ON MODERATE SOLAR RADIATION (SEE SHEET 34 & 35 OF 42)CONDITION "B"
3. PREVAILING WIND DIRECTION FROM THE EAST-NORTHEAST. ASSUMED CALM WIND. SEE SHEET 39 MOST CRITICAL CONDITION (REF. SAFETY ANALYSIS REPORT, 1975)
4. TAILINGS IMPOUNDMENT AND WINDBLOWN TAILINGS MAJOR RADON SOURCE FOR AIR SAMPLER S-3 SEE SHEET 22 FOR TOTAL
5. AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
6. WIND SPEED IS < 1MPH AT THE EAST-NORTHEAST DIRECTION (REF: SAFETY ANALYSIS REPORT 1975) SHEET 39

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet 23 of 42

Chkd. by: [illegible] Date: 8/10/89 Proj. No. 87-067-03

RADON ATMOSPHERIC DISPERSION

INT OF INTEREST: AIR SAMPLER S-3
JRCE: TAILINGS IMPOUNDMENT

EXISTING CONDITIONS
PRIOR TO CORRECTIVE ACTION PLAN

JSSIAN DISPERSION EQUATION:

EQ. 1 | EQ. 2 | EQ.3

* Q/2pie*u*oy*oz(EXP(-.5(Y/oy)^2)*(EXP(-.5(Z-H)^2/oz^2)+(EXP(-.5*(Z+H)^2/oz^2)
ERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

S-3 1988 AVERAGE: 2.2 X E-9 uCi/ml
BASED ON REPORTED 1988 QUARTERLY
CONCENTRATIONS SHEET 42

INPUT PARAMETERS:		RESULTS:	
- PRODUCTION RATE (pCi/sec)	5.60E+06	EQ. 1 =	1.25E+03 pCi/m^3
- AVERAGE WIND SPEED (mph)(m/sec) SHEET 39 2	0.894	EQ. 2 =	1.00E+00
- STAND DEVIATION OF Y DISP.	38	EQ. 3 =	7.05E-01
- STAND DEVIATION OF Z DISP.	21		
- DOWNWIND DISTANCE (ft)(m) FIG. 2 700	213.36	(1X2X3)/1E-12 =	8.81E-10 uCi/ml
- HORIZONTAL CROSS WIND DIST (m) 0	0		
- HIEGHT OF POINT OF INTEREST (m)	3		
- HIEGHT OF SOURCE (ft)(m) TECHNICAL SPEC 100 CANONIE, 1989	30.48	X =	8.81E-10 uCi/ml

TOTAL RADON CONCENTRATION FOR AIR SAMPLER S-3 = 1.41 E-10 uCi/ml + 7.57 E-10 uCi/ml = 2.2 E-9 uCi/
(WINDBLOWN TAILS)

SUMPTIONS:
UNIFORM, STEADY AND UNIDIRECTIONAL WIND
oy AND oz BASED ON MODERATE SOLAR RADATION (SEE SHEET 34/35 OF 42)
PREVAILING WIND DIRECTION FROM THE EAST-SOUTHEAST
MOST CRITICAL CONDITION (REF. SAFETY ANALYSIS REPORT, 1975)
TAILINGS IMPOUNDMENT AND WINDBLOWN TAILINGS MAJOR RADON SOURCE
FOR AIR SAMPLER S-3
AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
WIND SPEED OCCURED 5% OF DATA COLLECTION PERIOD (REF: SAFETY ANALYSIS REPORT 1975)
SHEET 29

Canonie Environmental

By PEC Date 8/15/89 Subject RADON PREDICTION Sheet No. 24 of ___

Chkd. By [illegible] Date 8/16/89 CALCULATION Proj. No. 88-067

1/4 X 1/4

PREDICTED CONCENTRATIONS

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 25 0

Chkd. by: [illegible] Date: 8/16/89 Proj. No. 88

RADON ATMOSPHERIC DISPERSION

POINT OF INTEREST: AIR SAMPLER S-1 POST-CORRECTIVE ACTION PLAN
SOURCE: TAILINGS IMPOUNDMENT AFTER ORE PLACEMENT

GAUSSIAN DISPERSION EQUATION:

EQ. 1 EQ. 2 EQ. 3

$$X = Q/2\pi\sigma_y\sigma_z\left(\exp(-.5(Y/\sigma_y)^2)\right)\left(\exp(-.5(Z-H)^2/\sigma_z^2)+\exp(-.5(Z+H)^2/\sigma_z^2)\right)$$

WHERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

INPUT PARAMETERS:			RESULTS:		
Q - PRODUCTION RATE (pCi/sec)		1.04E+07	EQ. 1 =	6.86E+01	pCi/
u - AVERAGE WIND SPEED (mph)(m/sec) SHEET 39	2	0.894	EQ. 2 =	1.00E+00	
oy - STAND DEVIATION OF Y DISP.		150	EQ. 3 =	1.97E+00	
oz - STAND DEVIATION OF Z DISP.		180			
X - DOWNWIND DISTANCE (ft)(m) FIG. 2	4500	1371.6	(1X2X3)*1E-12 =	1.35E-10	uCi/
Y - HORIZONTAL CROSS WIND DIST(ft)(m)	0	0			
Z - HEIGHT OF POINT OF INTEREST (m)		3			
H - HEIGHT OF SOURCE (ft)(m) TECHNICAL SPEC CANONIE, 1989	100	30.48	X =	1.35E-10	uCi/

ASSUMPTIONS:
1. UNIFORM, STEADY AND UNIDIRECTIONAL WIND
2. oy AND oz BASED ON MODERATE SOLAR RADIATION (SEE SHEET 34 TO 36 OF 42) CONDITION "B"
3. PREVAILING WIND DIRECTION FROM THE WEST-SOUTHWEST
   MOST CRITICAL CONDITION (REF. SAFETY ANALYSIS REPORT, 1975)
4. TAILINGS IMPOUNDMENT MAJOR RADON SOURCE FOR AIR SAMPLER S-1
5. AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
6. WIND SPEED OCCURRED 5% OF DATA COLLECTION PERIOD (REF: SAFETY ANALYSIS REPORT 1975)
   SHEET 29

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 26 OF 4

Chkd. by: [illegible] Date: 9/6/89 Proj. No. 88-06

RADON ATMOSPHERIC DISPERSION

POINT OF INTEREST: AIR SAMPLER S-2 POST-CORRECTIVE ACTION PLAN
SOURCE: TAILINGS IMPOUNDMENT AFTER ORE PLACEMENT

GAUSSIAN DISPERSION EQUATION:

EQ. 1 | EQ. 2 | EQ.3

$$X = Q/2pie*u*oy*oz(EXP(-.5(Y/oy)^2)*(EXP(-.5(Z-H)^2/oz^2)+(EXP(-.5*(Z+H)^2/oz^2)$$

WHERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

INPUT PARAMETERS:			RESULTS:	
Q - PRODUCTION RATE (pCi/sec)		1.04E+07	EQ. 1 =	3.09E+02 pCi/m^3
u - AVERAGE WIND SPEED (mph)(m/sec) SHEET 29 2		0.894	EQ. 2 =	1.00E+00
oy - STAND DEVIATION OF Y DISP.		80	EQ. 3 =	1.84E+00
oz - STAND DEVIATION OF Z DISP.		75		
X - DOWNWIND DISTANCE (ft)(m) FIG. 2	2500	762	(1X2X3)*1E-12 =	5.68E-10 uCi/ml
Y - HORIZONTAL CROSS WIND DIST (m)	0	0		
Z - HEIGHT OF POINT OF INTEREST (m)		3		
H - HEIGHT OF SOURCE (ft)(m) TECHNICAL SPEC CANONIE, 1989	100	30.48	X =	5.68E-10 uCi/ml

ASSUMPTIONS:
1. UNIFORM, STEADY AND UNIDIRECTIONAL WIND
2. oy AND oz BASED ON MODERATE SOLAR RADIATION (SEE SHEET 34/35 OF 42)
3. PREVAILING WIND DIRECTION FROM THE WEST-SOUTHWEST
   MOST CRITICAL CONDITION (REF. SAFTETY ANALYSIS REPORT, 1975)
4. TAILINGS IMPOUNDMENT MAJOR RADON SOURCE FOR AIR SAMPLER S-2
5. AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
6. WIND SPEED OCCURRED 5% OF DATA COLLECTION PERIOD (REF: SAFETY ANALYSIS REPORT 1975)
   SHEET 29

By: PEC Date: 8/8/89 Subject: RADON CONCENTRATION PREDICTION Sheet: 27

Chkd. by: T. Ram Date: 8-16-89 Proj. No. 88

RADON ATMOSPHERIC DISPERSION

POINT OF INTEREST: AIR SAMPLER S-3 POST-CORRECTIVE ACTION PLAN
SOURCE: TAILINGS IMPOUNDMENT AFTER ORE PLACEMENT

GAUSSIAN DISPERSION EQUATION:

EQ. 1 | EQ. 2 | EQ.3

$$X = Q/2\pi e^{*}u^{*}\sigma_y^{*}\sigma_z(EXP(-.5(Y/\sigma_y)^2)^{*}(EXP(-.5(Z-H)^2/\sigma_z^2)+(EXP(-.5^{*}(Z+H)^2/\sigma_z^2)$$

WHERE X = RADON CONCENTRATION AT POINT OF INTEREST (uCi/ml)

INPUT PARAMETERS:		RESULTS:	
Q - PRODUCTION RATE (pCi/sec)	1.04E+07	EQ. 1 =	1.62E+03 pCi/
u - AVERAGE WIND SPEED (mph)(m/sec) SHEET 39 2	0.894	EQ. 2 =	1.00E+00
σ_y - STAND DEVIATION OF Y DISP.	38	EQ. 3 =	1.19E+00
σ_z - STAND DEVIATION OF Z DISP.	30		
X - DOWNWIND DISTANCE (ft)(m) FIG. 2 700	213.36	(1X2X3)*1E-12 =	1.94E-09 uCi/
Y - HORIZONTAL CROSS WIND DIST(ft)(m) 0	0		
Z - HEIGHT OF POINT OF INTEREST (m)	3		
H - HEIGHT OF SOURCE (ft)(m) TECHNICAL SPEC 100 CANONIE, 1989	30.48	X =	1.94E-09 uCi/

ASSUMPTIONS:
1. UNIFORM, STEADY AND UNIDIRECTIONAL WIND
2. σ_y AND σ_z BASED ON MODERATE SOLAR RADIATION (SEE SHEET 34/35 OF 43)
3. PREVAILING WIND DIRECTION FROM EAST-SOUTHEAST
   MOST CRITICAL CONDITION (REF. SAFETY ANALYSIS REPORT, 1975)
4. TAILINGS IMPOUNDMENT MAJOR RADON SOURCE FOR AIR SAMPLER S-1
5. AIR SAMPLER DISTANCES BASED ON CANONIE DWG. NO. 88-067-A43
6. WIND SPEED OCCURED % OF DATA COLLECTION PERIOD (REF: SAFETY ANALYSIS REPORT 1975)
   SHEET 39. ≈ 2.7% Annual Calm

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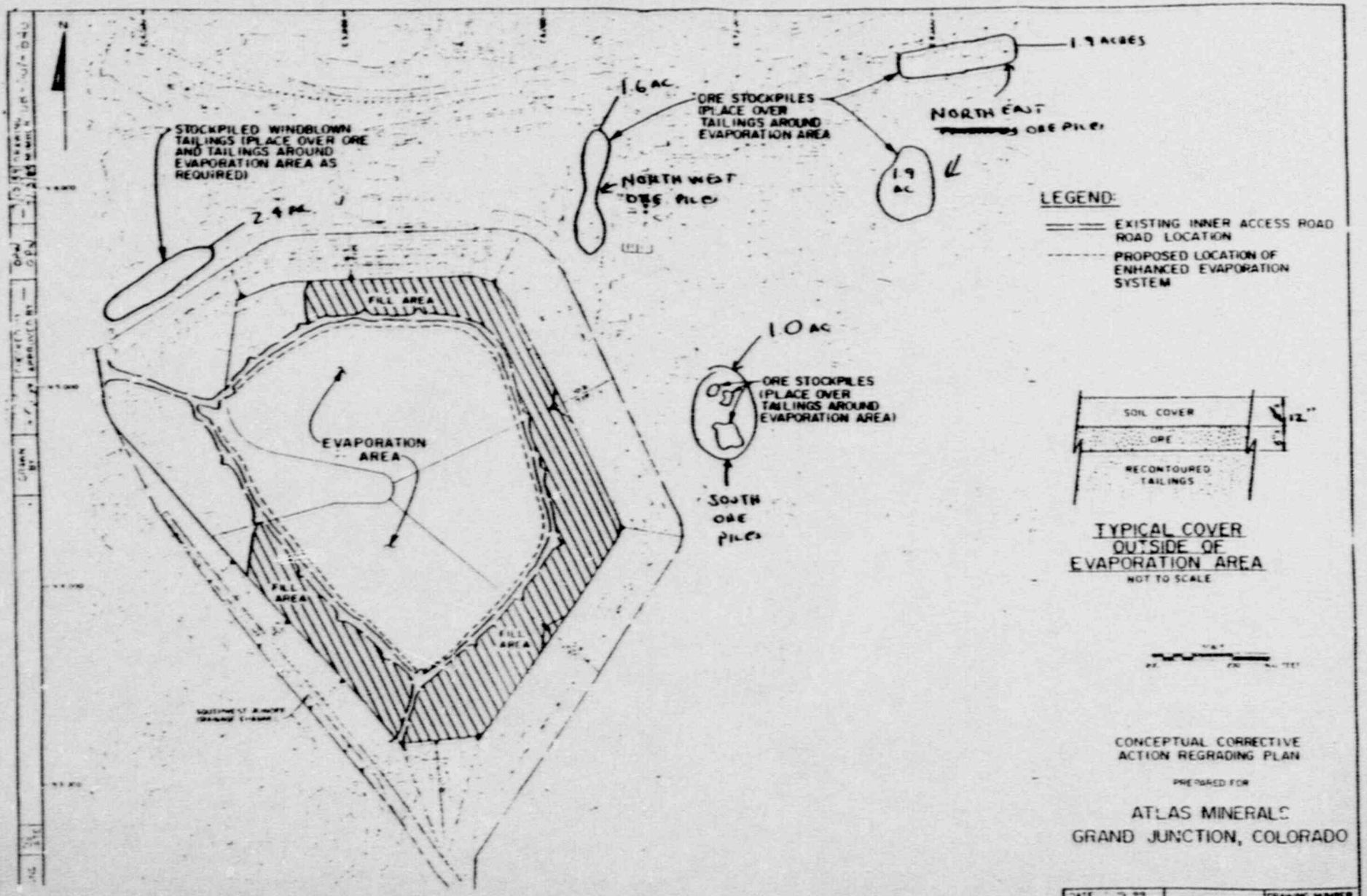
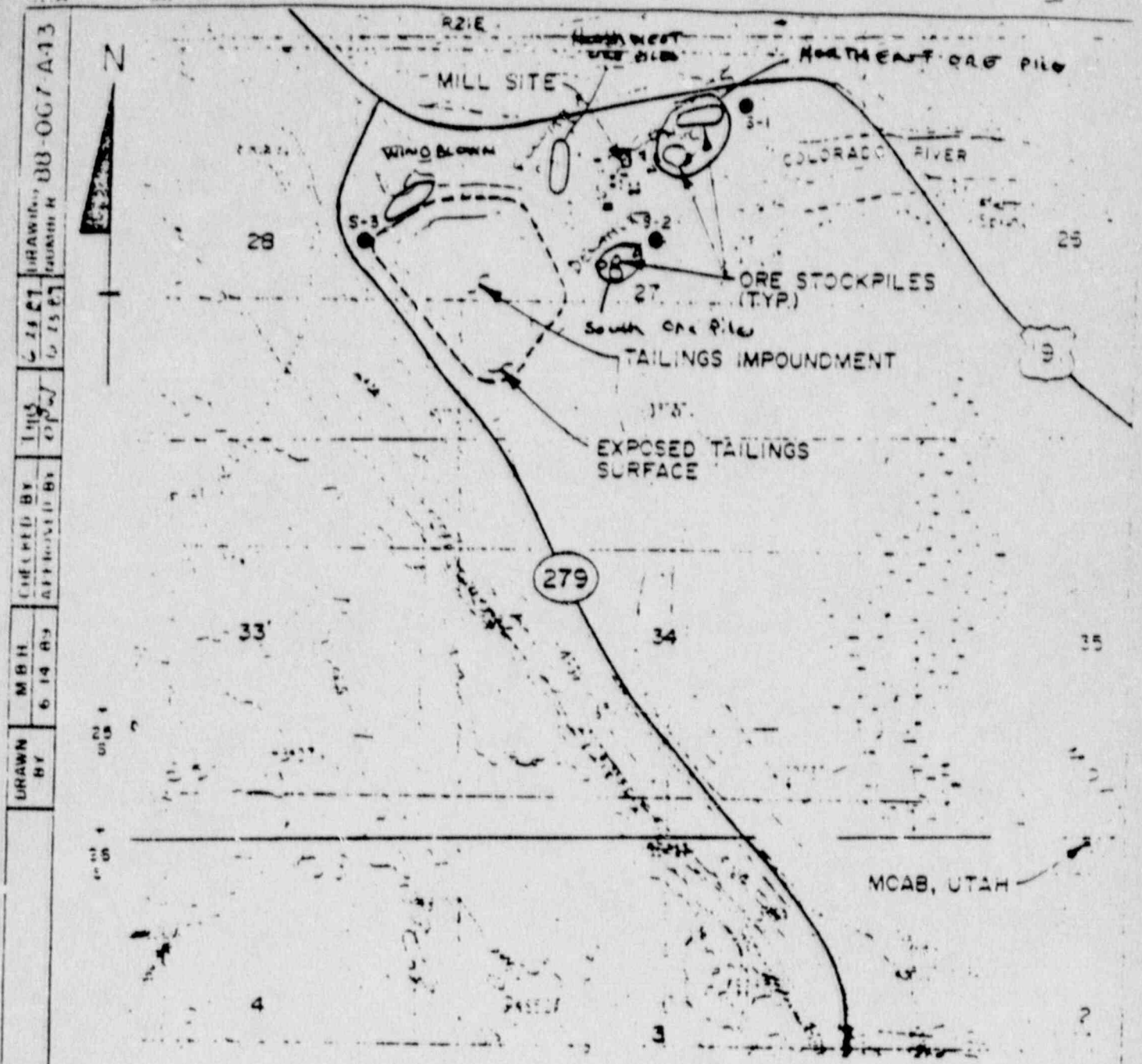
By ___ Date 8/1-/9? Subject ___ Sheet No 25 of ___

Chkd By ___ Date ___ ___ Proj No ___

1/4 X 1/4

FIGURES


N
STOCKPILED WINDBLOWN TAILINGS (PLACE OVER ORE AND TAILINGS AROUND EVAPORATION AREA AS REQUIRED)
2.4 AC
1.6 AC
ORE STOCKPILES (PLACE OVER TAILINGS AROUND EVAPORATION AREA
NORTH WEST ORE PILE
1.9 ACRES
NORTH EAST ORE PILE
1.9 AC
1.0 AC
ORE STOCKPILES (PLACE OVER TAILINGS AROUND EVAPORATION AREA)
SOUTH ORE PILE
FILL AREA
EVAPORATION AREA
FILL AREA
FILL AREA
LEGEND:
EXISTING INNER ACCESS ROAD ROAD LOCATION
PROPOSED LOCATION OF ENHANCED EVAPORATION SYSTEM
SOIL COVER
12"
ORE
RECONTOURED TAILINGS
TYPICAL COVER OUTSIDE OF EVAPORATION AREA
NOT TO SCALE
CONCEPTUAL CORRECTIVE ACTION REGRADING PLAN
PREPARED FOR
ATLAS MINERALS
GRAND JUNCTION, COLORADO



LEGEND:

- S-2 ● AIR MONITORING STATION APPROXIMATE LOCATION AND NUMBER
- 33 SECTION NUMBER

SCALE
2000 0 2000 FEET

ORE STOCKPILE AND AIR MONITORING STATION LOCATIONS

PREPARED FOR

ATLAS MINERALS
GRAND JUNCTION, COLORADO

Canonie Environmental

REFERENCE:
- 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP OF MOAB, UTAH. DATED: 1985. SCALE: 1" = 2000'. CONTOUR INTERVAL: 40'.

DATE 6-14-89 | SCALE AS SHOWN | FIGURE 2 | DRAWING NUMBER 88-067-A13

REFERENCES

Project 88-067
January 1989

Atlas Mine

Response to NRC Comments

Reclamation Plan
Uranium Mill and Tailings Disposal Area

Moab, Utah

Submitted by:

Atlas Minerals
Grand Junction, Colorado

Prepared by:

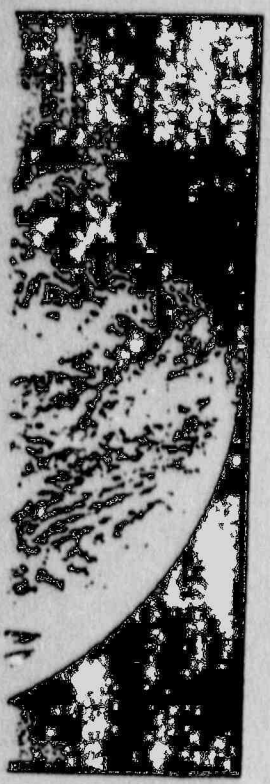
Canonie Environmental
Englewood, Colorado

Phillip E. Crouse

Canonie

331

ENVIRONMENTAL ENGINEERING



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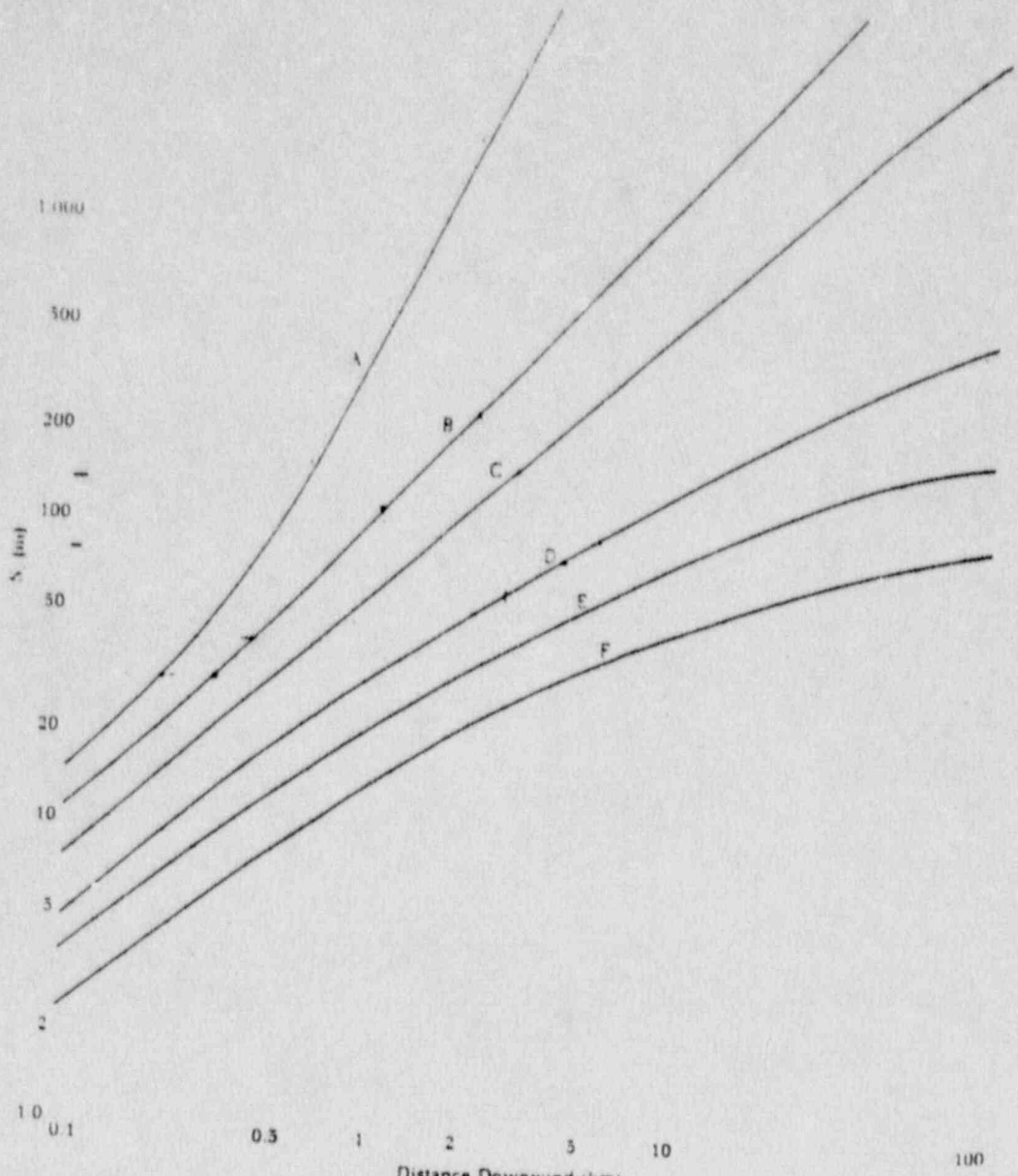

Figure 6-17 Vertical dispersion coefficient
(*Source*: Turner [see sourcenote for Figure 6-15], 1967.)

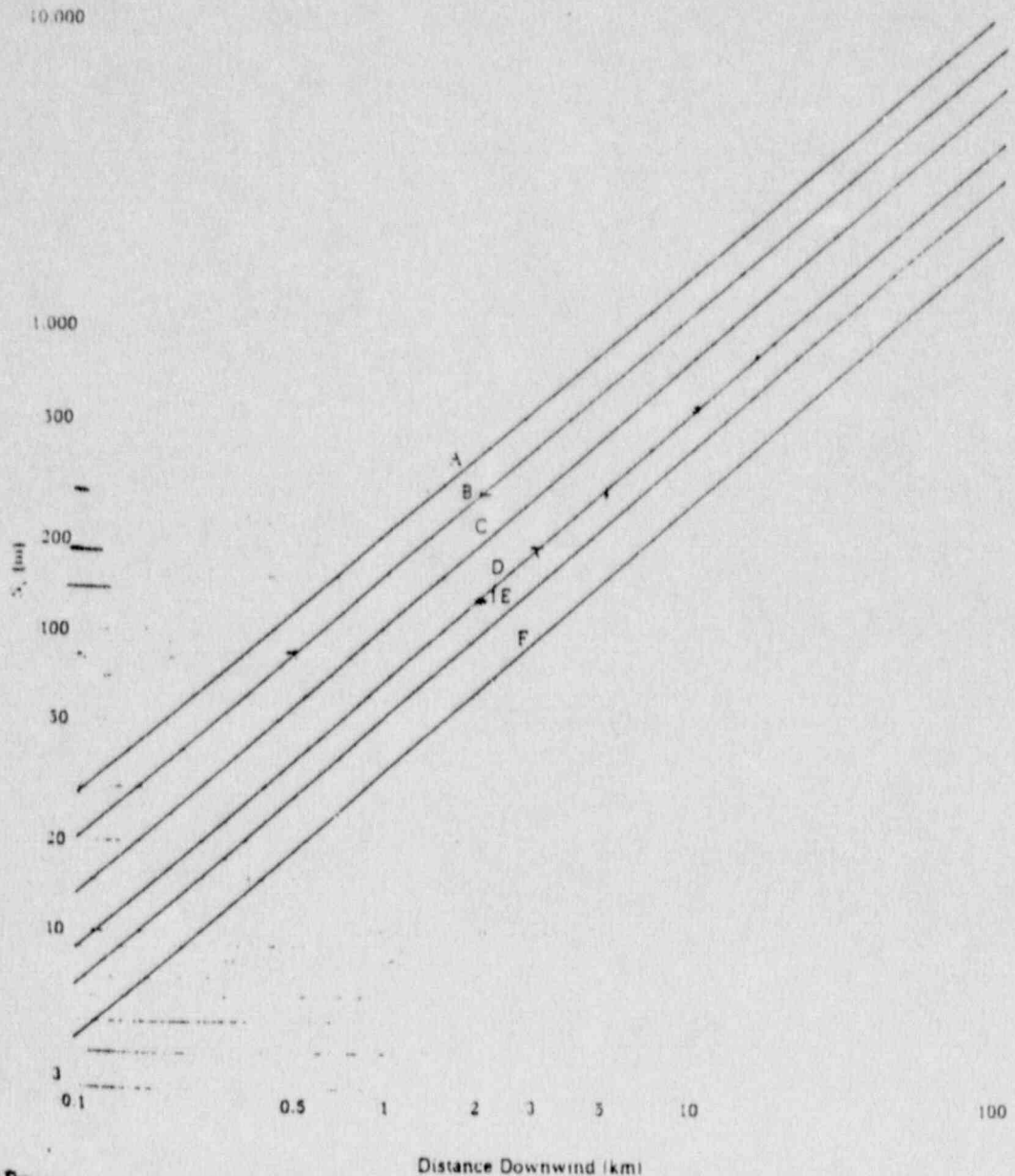

Figure 6-16 Horizontal dispersion coefficient
(*Source*: Turner (see sourcenote for Figure 6-15), 1967.)

Table 18-1. Atmospheric Stability Key for Figure 18-16

Surface Wind Speed (at 10 m) (m sec)	Day* Incoming Solar Radiation (Sunshine)			Night*	
	Strong	Moderate	Slight	Thinly Overcast or 4/8 Low Cloud	3/8 Cloud
<2	A	A-B	B	-	-
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D*	E
5-6	C	C-D	D	D	
>6	C	D	D	D	D

*The neutral category, D, should be assumed for overcast conditions during day or night.

100% efficient sink for the pollutants, and the levels must be higher at ground level due to inability of the plume to disperse into the ground. This effect can be taken into account if we think of an imaginary mirror image source at elevation $z - H$, as shown in Figure 18-17. Taking this into account, we can write

$$X_{(x,y,z)} = \frac{Q}{2\pi \hat{u} \sigma_y \sigma_z} \left(\exp\left\{-\tfrac{1}{2}[(y/\sigma_y)^2]\right\}\right) \times \left(\exp(-\tfrac{1}{2}[(z-H)^2/\sigma_z^2]) + \exp(-\tfrac{1}{2}[(z+H)^2/\sigma_z^2])\right)$$

Example 18.2

Given a sunny summer afternoon with average wind, $\hat{u} = 4$ m/sec, emission $Q = 0.01$ kg/sec, and the effective stack height 20 m, find the ground level concentration at 200 meters from the stack.

Using the above equation, and from Figure 18-16 finding that at 200 meters, $\sigma_y = 36$ and $\sigma_z = 20$ for an unstable superadiabatic strong solar radiation (Table 18-1), the atmospheric conditions are (Type B), and noting that maximum concentrations occur on the plume centerline, at $y = 0$

$$X_{x,y,z} = \frac{Q}{2\pi \hat{u} \sigma_y \sigma_z} \left(\exp\left\{-\tfrac{1}{2}[(y/\sigma_y)^2]\right\}\right) \times \left(\exp(-\tfrac{1}{2}[(z-H)^2/\sigma_z^2]) + \exp(-\tfrac{1}{2}[(z+H)^2/\sigma_z^2])\right)$$

$$X = \frac{0.01}{2(3.14)(4)(36)(20)} \left(\exp(-\tfrac{1}{2}[(0/36)^2])\right) \times \left(\exp\left\{-\tfrac{1}{2}[(0-20)^2/20^2]\right\} + \exp\left\{-\tfrac{1}{2}[(0+20)^2]\right\}\right)$$

April 1988

U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 3.64
(Task WM 503-4)

1st PMU 3-7-88

CALCULATION OF RADON FLUX ATTENUATION BY EARTHEN URANIUM MILL TAILINGS COVERS

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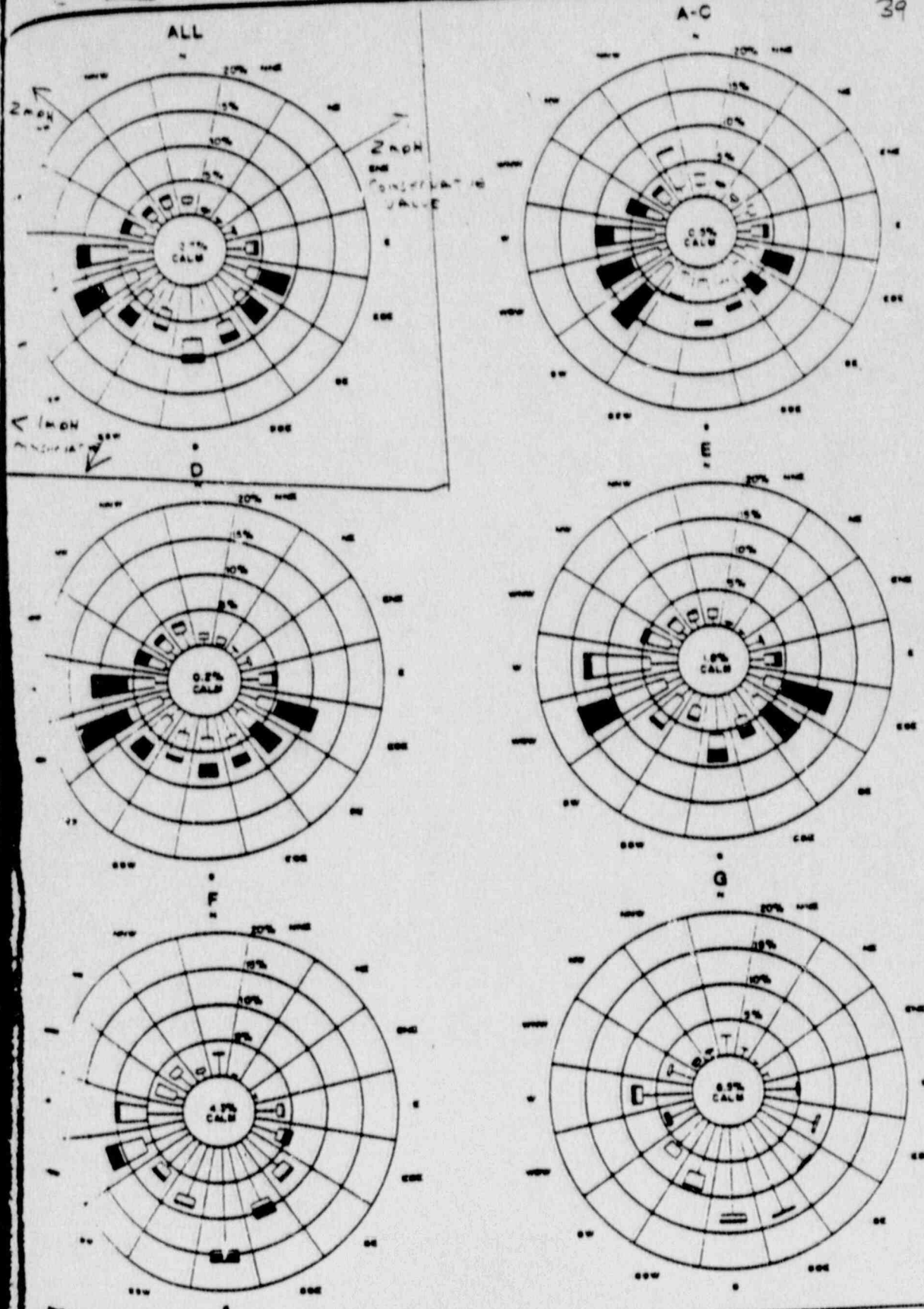
ATLAS MINERALS DIVISION

ATLAS CORPORATION

MOAB URANIUM MILL

DAMES & MOORE JOB NO. 5467-013-06



INSTRUMENT HEIGHT: 10 M

DATA PERIOD: 27 NOVEMBER 1974 THROUGH 31 MAY 1975

SAFETY ANALYSIS REPORT

ATLAS MINERALS DIVISION · ATLAS CORPORATION
MOAB URANIUM MILL

FIGURE 2.2-3

WIND ROSES FOR VARIOUS STABILITIES AT ATLAS MILL SITE, MOAB, UTAH

T. Dan 8/10/89

40/

ATLAS MINERALS
MOAB MILL

CONTINUOUS AIR SAMPLES
1988

CONTINUOUS AIR SAMPLE #1

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1988 Avg. % MPC	
U-Nat $x10^{-12}$ uCi/ml	.00063	.0014	.0034	.0035	.04	
Rn-222 $x10^{-10}$ uCi/ml	21.0	33.0	15.0	127.0	61.2	Avg = 49
Ra-226 $x10^{-13}$ uCi/ml	.0032	.0006	.0048	.0013	.06	
Th-230 $x10^{-14}$ uCi/ml	.016	.059	.16	.12	1.1	

ATLAS MINERALS
MOAB MILL

CONTINUOUS AIR SAMPLES
1988

CONTINUOUS AIR SAMPLE #3

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1988 Avg. % MPC
U-Nat $x10^{-12}$ uCi/ml	.00046	.0014	.00068	.0033	.03
Rn-222 $x10^{-10}$ uCi/ml	14.0	7.0	19.0	46.0	71.7
Ra-226 $x10^{-12}$ uCi/ml	.0092	.010	.0060	.0031	.23
Th-230 $x10^{-14}$ uCi/ml	.12	1.57	1.06	.63	10.6

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ATLAS MINERALS
MOAB MILL

CONTINUOUS AIR SAMPLES
1988

CONTINUOUS AIR SAMPLE #2

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1988 Avg. % MPC
U-Nat $x10^{-12}$ uCi/ml	.00088	.00013	.0019	.0036	.03
Rn-222 $x10^{-10}$ uCi/ml	22.0	57.0	51.0	159.0	240
Ra-226 $x10^{-12}$ uCi/ml	.00046	.00049	.00077	.00098	.02
Th-230 $x10^{-14}$ uCi/ml	.059	.059	.16	.26	1.68

Avg = 72.25

Across the River from #2 Station

4th Quarter 1987 = 1.5 pCi/L Rn-222
2nd Quarter 1988 = 1.0 " "
3rd Quarter 1988 = .9 " "
4th Quarter 1988 = Discontinued