USDA

United States Department of Agriculture

Office of the Assistant Secretary for Administration

Office of Procurement and Property Management

300 7th Street Southwest
Room 302
Reporters Building

Washington, DC 20024-9300

May 5, 2005

Q-2

John D. Kinneman
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406

Docket No.: 030-04530
License No.: 19-00915-03

Dear Mr. Kinneman:

'05 MAY 1 3:30 RECEIVED REGION 1

In accordance with the requirements of 10 CFR 30.36, I am submitting the U.S. Department of Agriculture (USDA) plan to decommission the low-level radioactive waste burial site at the Animal and Plant Health Inspection Service's (APHIS) Mexican Fruit Fly Rearing Facility in Edinburg, Texas. The USDA buried small volumes of low-level radioactive waste at two sites during the early to mid 1960's. The burials were performed in accordance with Federal regulations applicable at the time. This facility is on the list of radioactive waste burial sites previously reported to you as requiring decommissioning.

The enclosed remediation plan, prepared by our contractor (Integrated Environmental management, Inc.) is our decommissioning plan for the burial sites in Edinburg, Texas. APHIS has already begun a facility-wide hazardous materials remediation project in Edinburg and would like to include the remediation of the radioactive waste burial sites as part of this work. Therefore, we would appreciate your expedited review of the decommissioning plan so that we can finalize the plan prior to August 1, 2005.

136963
NMSS/RGNI MATERIALS-002

Thank you for your assistance in this matter. If you have any questions, please contact me on 301-504-2440.

Sincerely,

John T. Jensen
Director
Radiation Safety Staff

Enclosure

cc: w/out enclosures
R. Korcak, ARS
P. Petch, APHIS
W. Benson, APHIS

IEM

Integrated Environmental Management, Inc.

Remediation Plan for the Former Burial Sites at the Moore Air Base

BMT

BMT Entech, Inc.

Report No. 2005006/G-1299 (Rev. 0)

Appendix 12.3 - RESRAD Summary Report

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Pa N
3-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14	2.090E-06	2.090E-06	DCF2
3-1	H-3	6.400E-08	6.400E-08	DCF2
3-1	Ni-63	6.290E-06	6.290E-06	DCF2
D-1	Dose conversion factors for ingestion, mrem/pCi:			
)-1	C-14	2.090E-06	2.090E-06	DCF3
D-1	H-3	6.400E-08	6.400E-08	DCF3
D-1	Ni-63	5.770E-07	5.770E-07	DCF3
)-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(
-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(
-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(
D-34				
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(
-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(
D-34				
-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(
-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(
-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFA
-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFA
-5				
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFA
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFA
-5				
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFA
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFA

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by (If different f
R011	Area of contaminated zone (m**2)	1.000E+00	1.000E+04	---
R011	Thickness of contaminated zone (m)	3.000E-01	2.000E+00	---
R011	Length parallel to aquifer flow (m)	1.000E+00	1.000E+02	---
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---
R011	Times for calculations (yr)	not used	0.000E+00	---
R011	Times for calculations (yr)	not used	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): C-14	6.667E+03	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): H-3	4.756E+04	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Ni-63	2.822E+04	0.000E+00	---
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---
R013	Cover depth (m)	1.220E+00	0.000E+00	---
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---
R013	Irrigation mode	overhead	overhead	---
R013	Runoff coefficient	2.000E-01	2.000E-01	---
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by (If different f
3014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	--
R015	Number of unsaturated zone strata	1	1	--
3015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	--
3015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	--
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	--
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	--
3015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	--
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	--
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	--
R016	Distribution coefficients for C-14			
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---
016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---
016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.193I
016	Solubility constant	0.000E+00	0.000E+00	not us
R016	Distribution coefficients for H-3			
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---
016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.193E
016	Solubility constant	0.000E+00	0.000E+00	not us
R016	Distribution coefficients for Ni-63			
016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---
016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.111E
016	Solubility constant	0.000E+00	0.000E+00	not us
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---
017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---
R017	Exposure duration	3.000E+01	3.000E+01	---
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---
017	Shielding factor, external gamma	7.000E-01	7.000E-01	---
017	Fraction of time spent indoors	5.000E-01	5.000E-01	---
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circ

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by (If different f
017	Radii of shape factor array (used if FS = -1):			
017	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---
017	Outer annular radius (m), ring 3:	not used	0.000E+00	---
017	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---
017	Outer annular radius (m), ring 6:	not used	0.000E+00	---
017	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---
017	Outer annular radius (m), ring 10:	not used	0.000E+00	---
017	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---
017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	---
017	Ring 2	not used	2.732E-01	---
017	Ring 3	not used	0.000E+00	---
R017	Ring 4	not used	0.000E+00	---
R017	Ring 5	not used	0.000E+00	---
017	Ring 6	not used	0.000E+00	---
R017	Ring 7	not used	0.000E+00	---
R017	Ring 8	not used	0.000E+00	---
017	Ring 9	not used	0.000E+00	---
017	Ring 10	not used	0.000E+00	---
R017	Ring 11	not used	0.000E+00	---
017	Ring 12	not used	0.000E+00	---
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---
18	Milk consumption (L/yr)	9.200E+01	9.200E+01	---
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---
18	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---
18	Contamination fraction of drinking water	1.000E+00	1.000E+00	---
18	Contamination fraction of household water	not used	1.000E+00	---
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---
18	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---
R018	Contamination fraction of plant food	-1	-1	0.500E-
R018	Contamination fraction of meat	-1	-1	0.500E-
18	Contamination fraction of milk	-1	-1	0.500E-
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---
19	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---
19	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---
19	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---
19	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by (If different f
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---
R019	Depth of roots (m)	9.000E-01	9.000E-01	---
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---
R019	Household water fraction from ground water	not used	1.000E+00	---
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---
C14	DCF correction factor for gaseous forms of C14	8.894E+01	8.894E+01	---
STOR	Storage times of contaminated foodstuffs (days):			
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---
STOR	Leafy vegetables	1.000E+00	1.000E+00	---
STOR	Milk	1.000E+00	1.000E+00	---
STOR	Meat and poultry	2.000E+01	2.000E+01	---
STOR	Fish	7.000E+00	7.000E+00	---
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---
STOR	Well water	1.000E+00	1.000E+00	---
STOR	Surface water	1.000E+00	1.000E+00	---
STOR	Livestock fodder	4.500E+01	4.500E+01	---
R021	Thickness of building foundation (m)	not used	1.500E-01	---
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---
R021	Total porosity of the cover material	not used	4.000E-01	---
R021	Total porosity of the building foundation	not used	1.000E-01	---
R021	Volumetric water content of the cover material	not used	5.000E-02	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by (If different f
R021	Volumetric water content of the foundation	not used	3.000E-02	--
R021	Diffusion coefficient for radon gas (m/sec):			
R021	in cover material	not used	2.000E-06	--
R021	in foundation material	not used	3.000E-07	--
R021	in contaminated zone soil	not used	2.000E-06	--
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	--
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	--
R021	Height of the building (room) (m)	not used	2.500E+00	--
R021	Building interior area factor	not used	0.000E+00	--
R021	Building depth below ground surface (m)	not used	-1.000E+00	--
R021	Emanating power of Rn-222 gas	not used	2.500E-01	--.
R021	Emanating power of Rn-220 gas	not used	1.500E-01	--.
TITL	Number of graphical time points	32	---	--.
TITL	Maximum number of integration points for dose	17	---	--.
TITL	Maximum number of integration points for risk	257	---	--.

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1.00 square meters	C-14	6.667E+03
Thickness:	0.30 meters	H-3	4.756E+04
Cover Depth:	1.22 meters	Ni-63	2.822E+04

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000
TDOSE(t):	2.861E-26	1.662E+01	3.048E-03	4.785E-19	0.000E+00	0.000E+00	0.000E+00	6.064
M(t):	1.144E-27	6.648E-01	1.219E-04	1.914E-20	0.000E+00	0.000E+00	0.000E+00	2.426

laximum TDOSE(t): 1.716E+01 mrem/yr at t = 1.258 ± 0.003 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.258E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-uclide ɴuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
_-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.258E+00 years

Water Dependent Pathways

ıdio- ıclide Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
(14	1.283E+01	0.7475	1.759E+00	0.1025	0.000E+00	0.0000	9.157E-05	0.0000	4.298E-05	0.0000
H-3	2.574E+00	0.1500	7.984E-06	0.0000	0.000E+00	0.0000	1.690E-04	0.0000	5.927E-06	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.540E+01	0.8975	1.759E+00	0.1025	0.000E+00	0.0000	2.606E-04	0.0000	4.891E-05	0.0000

* um of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
C-14	2.861E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.861E-26	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.241E+01	0.7470	1.711E+00	0.1030	0.000E+00	0.0000	8.943E-05	0.0000	4.190E-05	0.0000
H-3	2.493E+00	0.1500	7.775E-06	0.0000	0.000E+00	0.0000	1.651E-04	0.0000	5.761E-06	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.491E+01	0.8970	1.711E+00	0.1030	0.000E+00	0.0000	2.546E-04	0.0000	4.766E-05	0.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
C-14	2.288E-03	0.7509	3.410E-04	0.1119	0.000E+00	0.0000	1.969E-08	0.0000	1.033E-08	0.0000
H-3	4.182E-04	0.1372	1.411E-09	0.0000	0.000E+00	0.0000	3.277E-08	0.0000	1.536E-09	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.707E-03	0.8881	3.410E-04	0.1119	0.000E+00	0.0000	5.245E-08	0.0000	1.187E-08	0.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.760E-19	0.7858	5.603E-20	0.1171	0.000E+00	0.0000	3.234E-24	0.0000	1.698E-24	0.0000
H-3	4.642E-20	0.0970	1.567E-25	0.0000	0.000E+00	0.0000	3.638E-24	0.0000	1.705E-25	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.224E-19	0.8829	5.603E-20	0.1171	0.000E+00	0.0000	6.872E-24	0.0000	1.868E-24	0.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
:-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
"i-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
i-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.665E-06	0.9342	6.974E-08	0.0115
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.665E-06	0.9342	6.974E-08	0.0115

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+0
-14	C-14	1.000E+00	4.292E-30	2.119E-03	3.944E-07	6.480E-23	0.000E+00	0.000E+00	0.000E+0
-3	H-3	1.000E+00	0.000E+00	5.242E-05	8.795E-09	9.763E-25	0.000E+00	0.000E+00	0.000E+0
Ni-63	Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+0

ßranch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j)
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

uclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1
-14	*4.454E+12	1.180E+04	6.338E+07	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12	*4
H-3	*9.594E+15	4.769E+05	2.843E+09	*9.594E+15	*9.594E+15	*9.594E+15	*9.594E+15	*9
i-63	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	1

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.258 ± 0.003 years

uclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
C-14	6.667E+03	1.258 ± 0.003	2.188E-03	1.143E+04	2.188E-03	1.143E+04
-3	4.756E+04	1.258 ± 0.003	5.416E-05	4.616E+05	5.412E-05	4.619E+05
Ni-63	2.822E+04	439.4 ± 0.9	9.163E-09	2.728E+09	0.000E+00	*5.916E+13

At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02
-14	C-14	1.000E+00	2.861E-26	1.413E+01	2.630E-03	4.320E-19	0.000E+00	0.000E+00	0.000E+0
-3	H-3	1.000E+00	0.000E+00	2.493E+00	4.182E-04	4.643E-20	0.000E+00	0.000E+00	0.000E+0
Ni-63	Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+0

RF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02
-14	C-14	1.000E+00	6.667E+03	3.702E+01	1.141E-03	1.857E-19	0.000E+00	0.000E+00	0.000E+0
-3	H-3	1.000E+00	4.756E+04	2.497E+02	6.881E-03	7.564E-19	0.000E+00	0.000E+00	0.000E+0
Ni-63	Ni-63	1.000E+00	2.822E+04	2.799E+04	2.753E+04	2.597E+04	2.198E+04	1.227E+04	2.318E+0

RF(i) is the branch fraction of the parent nuclide.

RESCALC.EXE execution time = 7.36 seconds

This report was prepared under the direction of
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Remediation Plan for the Former Burial Sites at the Moore Air Base

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Report No. 2005006/G-1299 (Rev. 0)
May 2, 2005

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1 INTRODUCTION

U. S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA/APHIS) performs research and development operations at the Moore Air Base (MAB) in Mission, Texas. Some of those operations involve the use of radioactive materials licensed by the U. S. Nuclear Regulatory Commission (USNRC).

The USDA/APHIS currently holds USNRC License No. 19-00915-03 which allows possession, use, storage, transfer and disposal of a variety of radioactive materials, including the §20.302 disposal of radioactivity.[1] The most recent amendment of License No. 19-00915-03 was last amended on April 8, 2005, and the license expiration date is September 30, 2005.[2]

Under the terms and conditions of that license, the USDA/APHIS historically operated four (4) discrete §20.302 burial locations at the MAB. Three of these are on what is identified as "Site 5", while the fourth is on "Site 6". As part of voluntary, on-going non-radiological site characterization and, if necessary cleanup program at these sites, the four burials were identified and scheduled for removal, with excavated materials to be disposed of as low-level radioactive waste.

The purpose of this report is to describe the remediation plan for the four burials. Included herein are the following chapters:

- Chapter 2 - *Facility Operating History*, describes the site's operating history, including licensed activities performed since the date of initial regulatory authorization.
- Chapter 3 - *Facility Description*, details the site locations and existing environmental conditions.
- Chapter 4 - *Radiological Status of the Burial Areas*, describes the radiological status of the locations scheduled for remediation.
- Chapter 5 - *Planned Remediation Activities*, describes the approach to be implemented in order to remediate the sites.

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[1] Title 10, Code of Federal Regulations, Section 20.302, "Method for Obtaining Approval of Proposed Disposal Procedures", 1992 (expired).

[2] The USDA also maintains a license to operate a Cobalt-60 irradiator. This is USNRC License No. 19-00915-06, last amended on March 21, 2005 and with an expiration date of September 30, 2005.

- Chapter 6 - *Project Management and Organization*, describes the project management and organization, including the role and responsibilities of key organizations and personnel.

- Chapter 7 - *Radiation Safety and Health Program*, describes the radiation safety and health program that will remain in place throughout the remediation process.

- Chapter 8 - *Radioactive Waste Management Program*, identifies the type, amount and disposition of radioactive materials associated with this remedial action.

- Chapter 9 - *Quality Assurance Program*, describes the elements of quality and the quality control measures to be implemented during remediation.

- Chapter 10 - *Final Status Surveys*, describes the way that the radiological conditions at the site, after remediation is complete, will be measured and documented.

BMT Entech, Inc. (BMT), a contractor to the USDA/APHIS, is performing the non-radiological remediation at the MAB. By way of a subcontract, BMT has authorized Integrated Environmental Management, Inc. (IEM), a USNRC Agreement State Licensee (Maryland Department of the Environment License No. MD-31-281-01) to prepare this plan. Once approved by the USNRC, it will be implemented in its entirety under the terms and conditions of the IEM license (and interstate reciprocity). At the end of the remedial actions, the final radiological status of the four burial locations will be assessed and documented prior to release of the locations for unrestricted use (i.e., without regard for radiological constituents).

2 FACILITY OPERATING HISTORY

2.1 General Facility Background[3]

The MAB facility was used as an Air Force base during World War II, and again during the Korean Conflict. After the war and up to the early 1960s, the airfield was used by the Tri-Cities as a municipal airport. The airfield was turned over to USDA in the early 1960s. USDA uses the field as a base of operation for APHIS activities in support of their Plant Protection and Quarantine (PPQ) section. In the past, sheep scrapie and screw worm programs were conducted at the facility. Current operations utilize the runway, apron system, and outbuildings that were constructed as part of the air base. Specific operations and facilities include:

- Facilities management.
- PPQ Mexican Fruit Fly Rearing Facility (MFFRF).
- Agricultural Research Service (ARS) Cattle Fever Tick Research and Cattle Fever Tick Eradication Programs.
- PPQ bird quarantine operations.
- PPQ aircraft maintenance and support.
- PPQ Biological Control Facility.
- Veterinary Service's Cattle Tick Quarantine Program.

2.2 Radiological Operations

During the early 1960's, a variety of radiological operations were performed at the MAB, including a program to sterilize screw worm pupae using a Cobalt-60 (Co-60) pool-type irradiator.[4] Rags and other debris, including a swimming pool pump and a filtering apparatus associated with a 1962 water clean-up campaign were disposed of in three subsurface burials at Site 5 of the MAB. Other analytical and tracer operations generated a variety of waste forms, including laboratory glassware, scintillation cocktails and "spent" radiation sources from analytical instruments.

[3] The preponderance of the information in this section was extracted from a BMT Entech, Inc. report entitled, "Streamlined Risk Release Report, Site 3, Moore Air Base, Mission Texas", performed under Contract No. 45-6395-2-4204", March 4, 2005.

[4] Worley, J. N. (APHIS), memo to J. Patterson (USDA Radiation Safety Staff), "Radioactive Waste Burial Sites at Moore Air Base, Mission, Texas", February 21, 1995.

3 FACILITY DESCRIPTION

3.1 Description and History [5]

The MAB is located in the Rio Grande Valley region of southern Texas in Hidalgo County, approximately 6 miles north of Alton, Texas. Current USDA operations utilize the runway, apron system, and outbuildings that were constructed as part of the air base. The present facility is a triangular shaped piece of land consisting of approximately 947 acres that is bounded on the east by FM 681, and the south and west by farmland. The northeastern corner of the site bounds a property (211 acres) that was once part of the air base. This section was severed from the original property in 1963 and sold to a private individual. The northeastern portion of the property once housed the barracks, medical facilities, recreational facilities, and other such operations of the air base.

Prior review of historical aerial photography indicates that the adjoining properties to the west and south have been used as ranch land, rangeland, and farmland since the construction of the MAB. During the ESA Phase I site visit, USDA officials indicated an ordnance storage facility was located to the northwest of the airfield.

The MAB has an independent wastewater treatment plant and collection system, water treatment plant and distribution system, water storage facility, and a burn pit/burial site, which is no longer in use. Stormwater runoff is collected and conveyed by a storm sewer system adjacent to the runways and is discharged to the roadside ditching on the west side of FM 681.

3.2 Topography and Soils

A review of the USGS topographical map of the MAB indicates the ground surface is gently sloping in a southeasterly direction at a grade of approximately 0.5%. The topographical map indicates the onsite surface runoff generally flows to a depressed area of approximately 22 acres, located in the southeast corner of the facility. There is a smaller depression located in the northwest corner of the site. The occasional pond can be found in some of the low-lying areas, which characterize the environs surrounding the air base. A drainage ditch beginning on the west side of FM 681 conveys surface water runoff from the air base in a southeasterly direction.

The surficial soils of the MAB were determined from the Soil Survey of Hidalgo County, Texas, as prepared by the USDA Soil Conservation Service (SCS). The predominant soil groups found within the study area are McAllen, Hidalgo, and Brennan. The soil types found in these groups are generally characterized by fine sandy loam at depths of approximately 0 to 18 inches, and sandy clay soils at depths of approximately 18 to 72 inches. The soil is well-drained with medium surface runoff and moderate permeability. Three minor soil groups are found in a 30-acre area and 20-acre area located

[5] The preponderance of the information in this chapter was extracted from a BMT Entech, Inc. report entitled, "Streamlined Risk Release Report, Site 3, Moore Air Base, Mission Texas", performed under Contract No. 45-6395-2-4204", March 4, 2005. All references for the materials cited herein are listed in that report.

in the northwest corner of the air base. The soil groups in these 2 areas are the Randado-Cuevitas, Ramadero, and Rio. The soil types found in these groups generally range from the sandy clay loam of the Ramadero to the clay and clay loam of the Rio. The Randado Group consists of layers of fine sandy loam, sandy clay, and caliche. The Ramadero and Randado are characterized by moderate to well-drained soils with slow runoff and moderate permeability, while the Rio is characterized by poorly-drained soil, with ponding, runoff, and slow permeability.

3.3 Geology

According to the Geologic Atlas of Texas, the MAB is underlain by the Goliad Formation. The Goliad Formation outcrops in a broad northward-trending band in eastern Starr and western Hidalgo Counties. The Goliad Formation attains a maximum thickness of up to 600 feet in Hidalgo County. This formation is from the Pliocene series of the Tertiary System, and is generally characterized by clay, sand, sandstone, marl, caliche, limestone, and conglomerate. There are 4 major sources of groundwater suitable for irrigation, public use, and industrial use in the Lower Rio Grande Valley as described in the USGS publication, Groundwater Resources of the Lower Rio Grande Valley. These sources are the lower Rio Grande groundwater reservoir, the Linn-Faysville groundwater reservoir, the Mercedes-Sebastian shallow groundwater reservoir, and the Oakville sandstone. The MAB is not located within the approximate productive areas of any of these groundwater reservoirs.

Based on this information, it can be deduced that the Goliad sand formation is likely present within the boundary of the air base. The Goliad sand formation yields small to moderate amounts of fresh to moderately saline water. During the Phase I ESA site visit, an abandoned water well was noted in the vicinity of the surface water storage reservoir. Depth to water was in excess of 300 feet. This possibly indicates that an attempt to obtain water from the local groundwater resource (most likely the Goliad sand formation) was made in the past.

3.4 Hydrogeology

The Goliad Formation, which outcrops at the facility, is part of the Gulf Coast Aquifer. The Gulf Coast Aquifer consists of inter-bedded clays, silts, sands, and gravels that are hydraulically connected on a regional scale to form a large, leaky artesian aquifer system. Wells completed in the Goliad Formation are capable of yielding small to moderate quantities of fresh to slightly saline water. In Hidalgo County, the Goliad Formation is considered to be a minor source of groundwater outside the areas of the Linn-Faysville and lower Rio Grande groundwater reservoir because of the low permeability and poor quality of water. Most of the wells tapping the Goliad Formation are used for stock watering or domestic use, but some wells are used for irrigation or public supply. A few wells produce water for industrial use. The quality of water in the outcrop area of the Goliad Formation at depths less than 200 feet differs considerably from place to place. At some locations in the outcrop area the water from shallow wells is of good quality, and at other locations the water is saline.

The uppermost water bearing unit at the MAB is the clayey and sandy silt stratum that occurs below a depth ranging from approximately 26 feet at monitoring wells MW-4 and MW-5 in the eastern portion of the site, to 69 feet at monitoring well MW-1 in the topographically higher western portion of the site. This saturated clayey and sandy silt stratum is overlain by low-permeability caliche and clay strata that act as upper confining units for the shallow groundwater.

Typical water level measurements in monitoring wells at the facility range from depths of 18 feet at monitoring well MW-5 to 51 feet at monitoring well MW-1. Water levels in monitoring wells were substantially higher than the depths of saturation encountered during well drilling. This indicates groundwater in the uppermost water bearing unit at the MAB occurs under confined conditions at these monitoring well locations. A piezometric surface map developed from the 5 originally installed monitoring wells at the MAB for the Phase II ESA indicates groundwater flow towards the north-northeast in the uppermost water bearing unit. The average hydraulic gradient was approximately 0.008 foot per foot.

3.5 Surface Water

The general direction of overland flow on the MAB is from the northwest and west to the southeast corner of the facility. Onsite stormwater flow from the northwest corner of the site is conveyed overland to a depressed area adjacent to the north end of the north-south oriented runway. From this area stormwater travels via a system of storm sewers and open ditches to a large drainage ditch, which begins at the southeast corner of the site. This drainage channel conveys stormwater under FM 681 via several culverts, which in turn outlet on the east side of FM 681 where the drainage continues to the southeast. Another low-lying area in the southeast corner of the site collects stormwater from the area south of the east-west oriented runway. This area is also situated in the 100-year floodplain according to the Flood Insurance Rate Map of Hidalgo County. Water from this portion of the site is also conveyed beneath FM 681 to the east, where it continues to the southeast. In general, the storm sewer system at the MAB is located adjacent to the aircraft runways and apron system, while open ditches are located adjacent to the access roads onsite.

The only surface water bodies present at the MAB consist of the wastewater lagoons associated with facility operations and ARS' Cattle Tick Fever research area, and the surface water reservoir, which provides feedwater to the onsite water treatment plant. Wastewater in the 2 lagoons that service the MAB wastewater treatment plant evaporates from the ponds or possibly infiltrates, as there were no visible discharges from these water bodies during a site visit in October 2003. Wastewater is typically present in only one of the two lagoons at the ARS complex. The first lagoon is constructed to overflow to the second, which was dry at the time of the October 2003 site visit. Wastewater in the first lagoon at the ARS complex evaporates and possibly infiltrates into the subsurface, as no discharge, other than the overflow to the second lagoon, is reported. The surface water reservoir in the southwest portion of the site receives precipitation and irrigation runoff from surrounding farmland. Water from this impoundment is pumped to the water treatment facility onsite for use at the various complexes around the MAB.

4 RADIOLOGICAL STATUS OF THE BURIAL AREAS

4.1 Site 5 Description

There are three (3) burial locations at Site 5 of the MAB, all of which contain Co-60.[6] Each of the burial locations have been nominally described as being four (4) to six (6) feet deep.[7] Once the excavations were made, the residual materials were placed inside (presumably without a liner) and the areas were backfilled. After an unspecified settling time, a final fill was added to "the level of the existing blacktop", and a six (6) inch thick concrete cap was installed.[8] The surfaces of the caps were then inscribed as follows: "Co-60 Contaminated Waste - Do Not Disturb", followed by the date (i.e., November 18, 1962).[9]

During a recent inspection of Site 5, the three burial sites were located.[10] All were confirmed to have their concrete caps in place. Furthermore, the cap inscriptions were exactly as described in the 1962 instructions. Therefore, the other provisions of the instructions are presumed to be just as reliable.

In correspondence dated February 25, 1965, there is reference to the burial of up to 10 millicuries of P-32 at an unspecified location on Site 5.[11] No additional information on that burial is available and there is no obvious physical evidence of its presence/location. However, the short half-life of P-32 (14.29 days) means that no detectable radioactivity would remain today even if the location were found. Therefore, no further action will be taken in response to the P-32 burial.

4.2 Site 5 Residual Radioactivity

There is no record of the amount of Co-60 that was placed into the three Site 5 burial locations. Therefore, because of the penetrating ability of the radiations emitted during the decay of Co-60 (1.173 and 1.332 million electron volts or MeV), an attempt to place an upper bound on the remaining amount was made by measurement.

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[6] Site 5 is colloquially referred to as the "Screw Worm Facility".

[7] Tuttle, J., BMT Entech, Inc., "RFP for Decommissioning Plan Preparation and Removal Oversight", February 11, 2005.

[8] Jefferson, M.E., memo to V. M. Blackwelder, "Commitments on Details to be Completed at Mission Irradiation Facility", November 16, 1962.

[9] It is presumed the P-32-bearing excavation was marked as containing P-32.

[10] Tuttle, J., personal communication to C. Berger, March 21, 2005.

[11] Jarrett, R. D., memo to F. Ribeiro, "Disposal of Radioactive Material at Moore Air Base, Mission, Texas", October 5, 1983.

On March 31, 2005, the ambient exposure rate at a height of one (1) meter above each of the three burial locations was measured. Appendix 12.1 contains the survey reports as well as the records for the radiation detection instrument used to make the measurements, showing that the ambient exposure rate over the concrete plugs could not be reasonably distinguished from background.

At issue then is the detection level of residual radioactivity by this measurement methodology. To answer this question, the computer code MicroShield was used.[12] This analytical tool is in widespread use for analyzing shielding constituents and estimating exposures from radionuclides that emit gamma radiation.[13] The following were also used as input to the MicroShield code:

- A "rectangular volume" geometry with two surface shields was selected to model the conditions within the burial locations.
- The source was modeled as a concrete plug with dimensions of six (6) inches by six (6) inches by six (6) inches and a density of 2.35 grams per cubic centimeter.[14]
- The soil backfill was modeled as a six-foot concrete shield with a density of 1.68 grams per cubic centimeter.[15]
- The concrete caps were modeled as a six-inch shield with a density of 2.35 grams per cubic centimeter.
- The dose rate of interest from a hypothetical deposit of one (1) microcurie of Co-60 is at a height of one (1) meter above the centerline of the concrete cap.

Appendix 12.2 contains the MicroShield summary report for this assessment, showing that the dose rate at a height of one (1) meter above the cap based upon the aforementioned assumptions would be 9.99×10^{-9} microR per hour above background. This is clearly undetectable in the presence of a nominal background exposure rate of eight (8) microR per hour. Therefore, while the amount of residual radioactivity is expected to be small, the fact that it cannot be bounded to an assuredly "safe"

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[12] MicroShield, Version 5.01-00996, Grove Engineering (An FTI Company).

[13] Several of the specific uses of this type of analysis include designing shields and containers, assessing radiation exposure to people and equipment, selecting temporary shielding for maintenance tasks, inferring source strength for waste characterization and disposal from external gamma radiation measurements, minimizing exposure to people, and teaching principles of radiation and shielding.

[14] The actual dimensions of the buried items are unknown. Therefore, the dimensions of the source used as input to the calculations are arbitrary. Also, because the excavations are reported to contain some combination of rags, filter cartridges, filters and pumps, it is reasonable to select a material with a mid-range density to simulate the actual placement.

[15] To ensure an element of conservatism in the calculation, the greatest reported excavation depth was used.

level means that the excavation of each of these areas must be handled cautiously, with continuous monitoring of ambient exposure rates throughout the process.[16]

4.3 Site 6 Description

Site 6 is referred to, colloquially, as the "Unknown Radioactive Burial Site". In correspondence dated October 31, 1983, the location of this burial appears to be approximately 800 feet north and 800 feet west from the southeast corner post of the MAB perimeter fence.[17] These materials were placed in a four-foot-deep bulldozer excavation, covered with dirt, and then packed down using the same bulldozer. Recent geophysical testing in the general location of the Site 6 burial failed to positively identify the burial location, although geophysical anomalies in that area were noted.[18] Figure 11.1 contains a map showing the suspected disposal location.

4.4 Site 6 Residual Radioactivity

In correspondence dated February 25, 1981, there is reference to the burial of an 83 millicurie Hydrogen-3 (H-3 or tritium) source from a gas/liquid chromatograph, a Nickel-63 (Ni-63) electron capture detector (activity unknown) and three (3) millicuries of Carbon-14 (C-14) waste from liquid scintillation counting experiments.[19] The following subsections present hazard assessments for these materials, demonstrating that their radiological impact even if the burial location were to be inadvertently uncovered at some time in the future would not result in demonstrable health effects.

4.4.1 Hazard Assessment for Inadvertent Recovery of Ni-63

A common source size for electron capture detectors is 15 millicuries of Ni-63. If this was the size of the buried source, the activity today, assuming a 100.1 year half-life for Ni-63, would be approximately 12.7 millicuries. Because Ni-63 emits only beta particles with an average energy of 17 thousand electron volts (keV) and a maximum energy of only 65.9 keV, it would not present a significant exposure hazard if handled cautiously.

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[16] Using conventional statistical method, the maximum possible activity in each burial that would be undetected in the midst of a background exposure rate of eight (8) microR per hour would be approximately:

$$E_{max} = \frac{2\sqrt{2 \times E_{bkg}}}{9.99\times10^{-9}}\ \mu Ci = \frac{2\sqrt{16\ \mu R/hr}}{9.99\times10^{-9}\ \frac{\mu R/hr}{\mu Ci}}\ \mu Ci \times \frac{1\ Ci}{10^{6}\ \mu Ci} = 800\ Ci$$

[17] Jarrett, R. D., memo to Files, "Radioactive Waste Disposal Sites at Moore Field, October 31, 1983.

[18] An A-E-I Environmental & Engineering Consultants, Inc., report entitled "Non-destructive Subsurface Investigation Conducted at: Moore Air Base, Mission, Texas" (submitted to BMT Entech, October 2003, Project #03073), identified four "disturbances" in the region of where the burial is thought to have been.

[19] Brown, H. E., memo to R. D. Jarrett, "Disposal of Radioactive Material at Moore Field, Mission TX", February 25, 1981 (plus enclosures).

4.4.2 Hazard Assessment for Inadvertent Recovery of C-14

The C-14 waste, because of its long half-life (i.e., 5,730 years), will not have decayed significantly since 1981, meaning there would still be approximately three (3) millicuries of C-14 in the burial location. Because C-14 emits beta particles with an average energy of 49.5 keV and a maximum energy of 156.5 keV, cautious handling upon excavation should not result in a significant exposure potential. Furthermore, since the C-14 is in the form of laboratory waste, intake by ingestion or inhalation is highly, meaning inadvertent or intentional recovery would not result in demonstrable health effects.

4.4.3 Hazard Assessment Inadvertent Recovery of for H-3

Since the date of placement, the H-3 source would have gone through almost two (2) half-lives. Therefore, it is reasonable to assume that approximately 21.4 millicuries may remain in the burial location. However, H-3 emits low-energy beta particles (i.e., 5.7 keV average energy and 18.6 keV maximum energy), thus it presents insignificant external exposure potential. Furthermore, because the annual limit on intake for H-3 is 80 millicuries, the internal dose potential for intake by inhalation or ingestion (i.e., less than 1.4 rem assuming 100% intake by a single individual) would not result in demonstrable health effects.

4.4.4 Hazard Assessment if Unrecovered (Pathways Analysis)

If the suspect radioactivity at Site 6 cannot be located and must be left in place, the question then becomes "what kind of radiation dose might a person incur as a result?" Because the magnitude of a specific person's radiation dose is dependent not only on the amount of radioactivity present but on the person's time and motion relative to the location of the radioactivity as well, person-specific doses can be difficult to assess. However, it is possible to perform a dose assessment that establishes a conservative estimate of exposure (i.e., one that is well above the average case) by assuming a constant and continuous presence at the site.

For this assessment, it was assumed that the "agricultural farm family" scenario is applicable. In this scenario, a hypothetical family is assumed to move onto site 6 directly over the spot where the residual radioactivity is thought to reside. For this scenario, it is assumed that a fictitious family builds a home and raises all of the crops and livestock for family consumption directly on the property. These fictitious family members may thus incur a radiation dose by <u>all</u> of the following pathways:

- Direct radiation exposure;
- Inhalation of re-suspended radioactivity;
- Ingestion of food from crops grown in the radioactivity;
- Ingestion of milk from livestock that grazes above the radioactivity;
- Ingestion of meat from livestock that grazes above the radioactivity;

- Ingestion of fish from an on-site pond contaminated by water percolating through the residual radioactivity; and

- Ingestion of water from a well on the property that is contaminated by water percolating through the residual radioactivity.

The reason for selecting the agricultural farm family scenario for this dose assessment is that exposure of permanent residents is long-term in nature, generally involves a greater number of exposure pathways than for non-residents, and results in a high, or conservative, estimate of potential radiation dose.[20] A computer code called RESRAD (Version 6.22) was used to model radionuclide fate and transport, and to assess the radiation dose incurred by the hypothetical family members from the residual radioactivity at Site 6.[21]

The following weighted mean radioactivity concentration for the various radionuclides present at Site 6, averaged over a soil volume of one meter by one meter by 0.3 meters (i.e., a soil volume of 0.3 cubic meters with a density of 1.5 grams per cubic centimeter) was used as input to the RESRAD computer code:

- Ni-63 - 28,222 picocuries per gram

- C-14 - 6,667 picocuries per gram

- H-3 - 47,556 picocuries per gram

The weighted mean concentrations, in conjunction with default input parameters supplied by the code, results in a maximum possible annual radiation dose that would be incurred by any member of the fictitious farm family resident at the site. The RESRAD code predicts that value to be 17 millirem in one year, which occurs at year 1.2, demonstrating that the dosimetric impact of leaving the residual radioactivity on Site 6 is trivial. Appendix 12.3 contains the RESRAD summary report for this assessment.

[20] The non-resident group most likely to receive exposure from the site is "scavengers". While scavenging can occur, this is not considered to be a likely scenario considering the lack of economic value of the buried radioactivity, and the fact that the exposure of scavengers will be much smaller than that of a hypothetical permanent resident since the scavenger will spend less time at the site than the resident.

[21] Argonne National Laboratory Technical Report (Yu, C., et al.). "A Manual for Implementing Residential Radioactive Material Guidelines Using RESRAD", ANL/EAD/LD-2, September, 1993.

5 PLANNED REMEDIATION ACTIVITIES

The residual radioactivity at Site 5 at the MAB will be excavated, packaged and shipped for disposal. Excavated areas (and any residual soils not included in the disposal shipment) will be surveyed, sampled, and released for unrestricted use. The following is a brief description of the remediation methodology:

- The concrete cover at each burial site will be removed (if present) and set aside to be surveyed for radiation and contamination levels.
- The soil beneath the concrete cover will initially be excavated using a backhoe.
- Soil will be removed in six inch lifts or less to minimize damage to burial containers that may be present and minimize contamination of the backhoe bucket once the buried materials are encountered.
- The soil that is removed from the excavation will be field-screened using a 2 in. by 2 in. sodium iodide - NaI(Tl) - detector as it is excavated.[22]
- When buried materials are uncovered, or when the excavation depth approaches the recorded burial depth, radiation and contamination surveys will be performed continuously and consideration will be given to excavating the remainder of the materials by hand using shovels or other appropriate tools.
- When the items alleged to contain the residual radioactivity are located and if they exhibit contact exposure rates that cannot be reasonably distinguished from background, they will be disposed of as industrial (non-radioactive) waste.
- Any soil or other materials that are found to be contaminated (i.e., exhibiting contact exposure rates that are distinguishable from background) will be placed into 55-gallon steel drums (or other suitable containers) and will be handled as described in Chapter 8 of this plan.

Once the waste materials are characterized, they will be manifested and transported to an offsite (and licensed) facility for processing and/or disposal. A final status survey will then be performed as described in Chapter 10 of this plan. The excavated areas will not be back-filled until such time as USNRC has had an opportunity to conduct any verification surveys/sampling. Regulatory verification

[22] Soil that exhibits count rates that are more than two times the background count rate will be segregated until their disposition is determined after the confirmatory analytical results are received.

surveys, if so desired, may be performed between the end of the on-site activities and when the excavated areas are backfilled.

In light of the minimal hazard associated with the residual radioactivity at Site 6 (see Section 4.4, above), the fact that the exact burial location cannot be positively identified using conventional geophysical techniques, and because the radiations emitted by those materials cannot be readily identified using hand-held detection instruments, the following is the remediation methodology for Site 6:

- The soil covering the presumed burial location will initially be excavated using a backhoe.

- Soil will be removed in six inch lifts or less to minimize damage to burial containers that may be present and minimize contamination of the backhoe bucket once the buried materials are encountered and physically identified.

- When buried materials are uncovered, or when the excavation depth reaches the recorded burial depth, consideration will be given to excavating the remainder of the materials by hand using shovels or other appropriate tools.

- Any soil in the immediate vicinity of the residual radioactivity, along with the buried waste itself, will be placed into 55-gallon steel drums (or other suitable containers) and will be handled as described in Chapter 8 of this plan.

- If the buried materials are not found when the excavation reaches a depth of six feet and a spatial diameter of 20 feet by 20 feet centered on the suspected burial location, the excavated area will be backfilled with no further attempts to locate the residual radioactivity.

6 PROJECT MANAGEMENT AND ORGANIZATION

The USDA/APHIS will maintain primary responsibility for all site activities conducted under the requirements of License No. 19-00915-03. However, because this license does not permit the implementation of remedial actions, a licensed Decommissioning Contractor will perform the work under provisions of interstate reciprocity. Figure 11.2 shows the organizational structure for the project. This streamlined arrangement serves to minimize administrative functions, keeps overhead costs to a practical minimum, provides maximum flexibility for resource allocation, and facilitates USDA/APHIS oversight of all remedial actions. The following subsections contains brief descriptions of the project organization.[23]

6.1 Decommissioning Contractor

The USDA/APHIS, through nationwide environmental services contractor BMT, will retain a Decommissioning Contractor to implement this Plan subject to the USDA/APHIS's direction and control. Integrated Environmental Management, Inc. (IEM), a Maryland Department of the Environment licensee (License No. MD-31-281-01) who is authorized by that agency to implement this plan, will serve as the Decommissioning Contractor under provisions of interstate reciprocity.[24,25] IEM, under subcontract to BMT, will prepare the final work plans, pre-qualify and select all subcontractors (i.e., radiological laboratories, waste disposal services), monitor subcontractor performance, perform and document Final Status Surveys, facilitate communications with regulatory authorities, and provide on-site project management and site-specific health and safety support (radiological and general safety support) during the remediation.

6.2 Contractor Support

The efforts of the Decommissioning Contractor will be focused on nuclear, health and safety, regulatory compliance, and project management matters. Specialty services necessary to complete all aspects of this Plan (e.g., security, waste disposal, heavy equipment operations, labor, analytical, etc.) will be assigned to firms with appropriate skills and experience. However, each firm will designate a Task Manager and, as necessary, a health and safety and/or QA contact. The following is a listing of the contractor support firms:

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[23] A single individual may serve one or more roles during implementation of this Plan. Likewise, each role described herein may be fulfilled by more than one individual. Those individuals specifically assigned to each role will be named and their qualifications maintained on-site for regulatory inspection.

[24] IEM has invoked the terms of License No. MD-31-281-01 under provisions of USNRC reciprocity in the past.

[25] In addition to maintaining an approved radiation safety program, IEM also has demonstrated experience in facility and land-area decommissioning, industrial safety/surveillance, radiological safety/surveillance, license/regulatory interactions, negotiations and compliance demonstration, developing technical bases for radiological operations, and preparing standard operating procedures to implement these technical bases.

- BMT Entech - BMT Entech, Inc. (BMT), a full-service environmental firm currently tasked with non-radiological assessment and remedation at the MAB, will provide project personnel to perform the excavations and assist the IEM Project Manager in sample collection, waste packaging, transportation and other items related to the implementation of this plan.

- Outreach Laboratory - Outreach Laboratory, in Broken Arrow, Oklahoma, will provide the analytical services necessary to support the final status survey of the four burial locations. Outreach Laboratory maintains an industry-standard quality assurance program, participates in a variety of intercomparison and cross-comparison studies, and is Certified by the National Environmental Laboratory Accreditation Conference (NELAC).[26]

- Waste Transporter/Processor - A firm will be selected to provide the waste brokering/manifesting/transportation services for the project radioactive waste that is generated. The firm selected will maintain a group of trained radioactive waste brokers/shippers, have valid disposal permits at the various low-level waste disposal sites, offer optimum and applicable treatment/disposal solutions and will have appropriately licensed and insured transportation capabilities.

- Licensed Disposal/Treatment facilities - Final waste treatment and disposal facilities will be identified and contracted once the excavated wastes are adequately characterized for disposal.

6.3 Project Manager

The Decommissioning Contractor will designate an individual to serve as the Project Manager. The Project Manager, who will be qualified as an Authorized User on License No. MD-31-281-01, will be responsible for the following:

- Verifying that all project personnel are provided with the proper radiation protection, industrial safety training and possess the requisite knowledge of the details of the job assignment;

- Observing work in progress to verify adherence to the radiological and industrial safety rules and procedures;

[26] NELAC is a voluntary association of State and Federal agencies established to ensure mutually acceptable performance standards for the operation of environmental laboratories. The U. S. Environmental Protection Agency's National Environmental Laboratory Accreditation Program (NELAP) office provides support to NELAC and evaluation of the accrediting authority programs.

- Recommending changes to operational and radiological protection practices to project personnel;
- Enforcing compliance with the USDA/APHIS site rules and IEM license requirements;
- Reviewing reports and results provided by the laboratory subcontractor; and
- Establishing and maintaining a records management system to verify that project documents, such as correspondence, procedures, drawings, specifications, contract documents, changes to documents, and inspection records are controlled.

Copies of all work plans, reports and other project documentation will be provided to BMT, the USDA/APHIS prime contractor.

6.4 Site Health and Safety Officer

Reporting to the Project Manager will be the Site Health and Safety Officer (Site HSO). This individual will be present at the MAB for the duration of all on-site work, will be qualified as a "Health Physics Technician" pursuant to IEM's Radiation Protection Program Plan, and will be knowledgeable in the following radiation protection and industrial safety subjects:

- Principles and practices of radiation protection;
- Radioactivity measurements, monitoring techniques, and the use of instruments;
- Mathematics and calculations basic to the use and measurement of radioactivity;
- Biological effects of radiation;
- Safety practices applicable to protection from radiation, chemical toxicity, and other properties of the materials that may be encountered during the remedial action;
- Conducting radiological surveys and evaluating results;
- Evaluating and implementing the final work plans for proper operations from a radiological safety standpoint;
- Applicable MDE, Texas Commission on Environmental Quality (TCEQ), USNRC, USEPA, and OSHA regulations; and
- The requirements of MDE License No. MD-31-281-01.

The responsibilities of the Site HSO will include, but are not limited to the following:

- Establishing the health and safety program requirements for field activities;
- Verifying that project personnel implement the requirements of the industrial safety and radiation protection program adequately;
- Reviewing the results of surveys, sampling, and environmental monitoring to identify trends and potential for personnel exposure;
- Evaluating the effectiveness of engineering and administrative control including the requirements for personnel protective equipment;
- Developing new safety protocols and procedures necessary for unanticipated field activities;
- Providing internal IEM review and approval for work related documents;
- Auditing key aspects of the safety and health program; and
- Making recommendations to the Project Manager regarding the control of existing and potential industrial, chemical and radiological hazards.

The site HSO will be responsible for implementing the IEM Radiation Protection Program Plan during the performance of the MAB remediation. As such, this individual has the authority to terminate any work activities at the MAB that do or may violate regulatory requirements for radiological protection (see IEM's written procedure on stop-work authority).[27]

6.5 Quality Assurance Officer

The Decommissioning Contractor will also assign a Quality Assurance Officer (QAO) for the project. The QAO, who will be Certified in the Comprehensive Practice of Health Physics by the American Board of Health Physics, will perform the following:

- Technical assistance and peer review of all deliverables;
- Coordinate with analytical laboratories, as necessary;
- Track laboratory submittals and sample analyses and verify delivery of data, as necessary;

[27] IEM maintains a series of Radiation Safety Procedures (RSPs) that are attached by reference to License No. MD-31-281-01. A hard copy of each RSP will be maintained at the MAB work site for the duration of the on-site activities.

- Coordinate validation of analytical data;
- Monitor the status of on-site activities; and
- Prepare and submit QA reports, as required.

7 RADIATION SAFETY AND HEALTH PROGRAM

Industrial safety and health of all participants in this project will be performed pursuant to a site health and safety plan that has been developed and is being implemented by BMT.[28] However, all radiation safety procedures will be performed pursuant to License No. MD-31-281-01, the IEM Radiation Protection Program Plan, and the site-specific requirements outlined in the following subsections.

7.1 Training

All employees, contractors, and visitors with unescorted access to the work zones at the MAB will be instructed in the type and magnitude of the radiological hazards they might face. All personnel performing the on-site work described in this Plan will be trained pursuant to IEM's written procedure on radiation safety training and qualification of radiation safety personnel The following subsections briefly describe the various training programs that will be implemented as part of this Plan.

7.1.1 Visitor Training

Visitors to the work zone will be trained by reading and signing a briefing form. The briefing form will contain information about the hazards present in the work zone, and the requirement that all visitors be escorted while in the work zone.

7.1.2 General Employee Training

General Employee Training in Radiation Protection (GET) will be administered to all project employees with the potential to receive in excess of 100 millirem TEDE while performing work at the MAB. GET, provided to the start of work on this remediation effort, will consist of an oral presentation by the Site HSO, hand-out of materials, and completion of a form acknowledging receipt of training. GET will address the following topics:

- The type and form of radioactive material present at the work site.
- The location of IEM radiation protection policies and procedures.
- Personnel responsibilities for radiation safety.
- Identification of radiation postings and barriers (if any).
- Protective equipment and procedures.
- Work zone setup and decontamination procedures;

[28] BMT Entech, Inc., "Moore Air Base: Master HASP, Moore Air Base, Mission, Texas" (Final), August 2003.

- Emergency procedures; and
- How to contact IEM and project radiation safety staff.

7.1.3 Tailgate Safety Training

Tailgate safety meetings will be conducted at the beginning of each work shift, whenever significant changes are made in job scope or whenever new personnel arrive at the job site. The meetings will present health and safety procedures and issues for the day, any unique hazards associated with an activity, and review any significant topics from previous activities. The information discussed will be recorded, which will serve as confirmation that the information was presented to those persons whose signatures are on the form.

7.1.4 Training Records

The tailgate training form will capture the following information: the facility, date, time, task number, type of work, hazardous/radioactive materials used, protective clothing/equipment, chemical hazards, radiological hazards, physical hazards, emergency procedures, hospital/clinic, phone, paramedic phone, hospital address, special equipment and any other safety topics that may be relevant. In order to exempt persons from the required training for any reason, a form as described in IEM's written procedure on training will be completed and maintained on-site for regulatory inspection. GET training will be documented as described in section 7.1.3 above

7.2 Personal Protective Equipment

Personnel will wear protective equipment when project activities involve potential exposure to chemicals or radioactive contamination that may be present during the implementation of this plan. The presence of chemical hazards is unlikely unless they are uncovered when removing the cement caps on the excavations. However, radioactive materials are likely to be encountered as the potential for residual radioactivity exists in all of the burial locations.[29]

7.2.1 Levels of Protection

When there is a potential to come in contact with radioactive or chemical contamination, personnel will don Modified Level D personal protective equipment(PPE). Modified Level D PPE consists of the following equipment:

- Tyvek coveralls (polycoated Tyvek when handling or working with liquids);
- Steel toe work boots;
- Outer work gloves (leather or cut resistant)

[29] As shown in Section 4.4, above, the radiological impact of the materials in the burial at Site 6 do not present a health hazard.

- Outer PVC or latex contamination gloves;
- Safety glasses;
- Hard hats when exposed to overhead hazards, and
- Hearing protection when in noisy environments.

When there is no potential to contact radioactive or chemical contamination, employees will wear Level D PPE, which consists of:

- Steel toe work boots;
- Gloves as necessary;
- Hearing protection as necessary.

PPE will be maintained in a clean sanitary condition and ready for use. Disposable coveralls shall be discarded when torn and as an employee leaves the contaminated zone. A sufficient quantity of potable water shall be supplied for washing and drinking. Fresh potable water for drinking will be supplied on a daily basis and be maintained at a location removed from the active work area.

7.2.2 Assessment of PPE

Protection levels provided by PPE will be upgraded or downgraded based upon a change in site conditions or the review of the results of radioactive contamination monitoring. The Project Manager will notify the site employees if it is necessary to upgrade to a higher level of protection.

When a significant change occurs, the hazards shall be reassessed. Some indicators of the need for reassessment include but are not limited to the following:

- Commencement of a new work phase;
- Change in job tasks during a work phase;
- When temperature extremes or individual medical considerations limit the effectiveness of PPE;
- Chemicals other than those expected to be encountered are identified;
- Change in airborne concentrations of hazardous chemicals; or
- Change in work scope that effects the degree of contact with areas of potentially elevated chemical presence.

Any proposed changes to protection levels and PPE requirements will be reviewed and approved prior to their implementation by the IEM Project Manager. The Site HSO will be notified in the event of spread of radioactive contamination outside of the controlled areas.

7.2.3 Limitations of PPE

PPE ensembles designated for use during project activities have been selected to provide protection against chemicals at known or anticipated concentrations in the waste materials. However, no protective garment, glove, or boot is chemical-proof, nor will it afford protection against all chemical types. Permeation of a given chemical through PPE is a complex process governed by the chemical concentrations, environmental conditions, physical condition of the protective garment, and the resistance of a garment to a specific chemical; chemical permeation may continue even after the source of the chemical has been removed from the garment.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all personnel using PPE:

- When using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift;

- Inspect all clothing, gloves, and boots both prior to and during use for (1) imperfect seams; (2) non-uniform coatings; (3) tears; and (4) poorly functioning closures.

- Inspect reusable garments, boots, and gloves both prior to and during use for: (1) visible signs of chemical permeation; (2) swelling; (3) discoloration; (4) stiffness; (5) brittleness; (6) cracks; (7) any sign of puncture; and (8) any sign of abrasion.

Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above will be discarded. PPE used in areas known or suspected to exhibit elevated concentrations of chemicals will not be reused in spite of their post-use radiological status.

7.3 Radiation Monitoring

Radiation and contamination surveys during remediation activities will be conducted in accordance with procedures authorized under IEM's license to handle radioactive material.[30] The purposes of these surveys is to protect the health and safety of workers, protect the health and safety of the general public and demonstrate compliance with applicable license, and federal requirements.

Control levels have been established for this remedial action. Based upon knowledge of the radiological constituents present at the MAB and existing radiation exposure rates, it is expected that

[30] US Nuclear Regulatory Commission, *Standards for Protection Against Radiation*, Title 10, Code of Federal Regulations, Part 20.

maximum individual personnel radiation exposures will not exceed 100 millirem TEDE over the duration of the project. Surveillance will be performed by the Site HSO to verify that exposures are minimized and within acceptable guidelines. If radiological conditions that may subject individuals to radiation doses in excess of 500 millirem for the duration of the project are encountered, only trained, radiation workers will perform the work in those areas.[31]

7.3.1 External Radiation Monitoring

Monitoring for radiation exposures from sources that are outside of the body (external exposure monitoring), is not warranted for this project. The radioactive isotopes expected to be encountered in the four burial areas are either void of penetrating radiation or the exposure durations will be short enough to ensure no individual incurs an external dose equivalent in excess of 100 millirem.

As stated in Section 4.2 above, the amount of residual Co-60 in all three of the burial locations at Site 5 of the MAB is expected to be small, but that cannot be confirmed in advance of the on-site effort. Therefore, the Site HSO will monitor the exposure rate as each excavation progresses. If work area rates in excess of two (2) mR per hour are encountered, the following will occur:

- Work in the area will cease until the Site HSO evaluates the exposure potential in light of monitoring requirements.

- External exposure monitoring pursuant to IEM's Radiation Safety Procedure on this topic will be implemented for all personnel who may be subjected to the following conditions:

  $$T\ (hr) \times R\ (mR/hr) > 300\ mR$$

  where T = the time necessary to complete the project and R = the maximum measured ambient exposure rate.

- The Site HSO will specify optimum "time", "distance" and "shielding" exposure controls.

- Project personnel will be instructed in the modified safety and monitoring provisions, and in the radiological conditions in the work area prior to the re-start of work in that area.

7.3.2 Internal Radiation Monitoring

Monitoring for radioactive material that may be inhaled or ingested (internal exposure monitoring), is not warranted for this project. Neither air sampling nor urine bioassays are deemed necessary because of the nature of the radioactive contamination and the limited potential for directly handing

[31] The scope of radiation worker training is outlined in IEM's written procedure on training.

of loose radioactive materials during the implementation of this plan. The Site HSO will monitor changing conditions and verify that the methods used to minimize the spread of contamination are effective. As necessary, the provisions of IEM's written procedure on internal radiation monitoring will be implemented.

7.3.3 Contamination Reduction Methods

IEM is committed to reducing exposures to radioactive materials and direct radiation to as low as reasonably achievable (ALARA). Therefore, significant emphasis will be placed on the control of contamination. The principle sources of contamination during the project are those encountered during the excavation and packaging of residual radioactivity in the burial areas.

The Site HSO will monitor radiological conditions during each excavation, set up and enforce contamination control zones as necessary, verify that personnel working in areas with contamination potential use PPE correctly, and complete radiation surveys before leaving the exclusion zone. In addition, and prior to demobilization, potentially contaminated equipment will be decontaminated and inspected by the Site HSO before it is moved into the clean zone. Records of release surveys will be maintained on standardized forms.

7.3.4 Surface Contamination Control Levels

Controls shall be implemented to limit exposures to radioactive materials if the following action levels are exceeded:

- A surface will be considered contaminated if the removable beta contamination exceeds 200 dpm/100 cm^2 or if the total (fixed) activity exceeds 1,000 dpm/100 cm^2 when averaged over not more than one (1) square meter.

- A surface will be considered to be contaminated if the total (fixed and removable) beta/gamma activity produces a dose equivalent rate in excess of 0.25 mrem/hour at 1 centimeter from the surface.

The site HSO will verify that all personnel involved in the sampling activity have completed the required contamination survey prior to their exiting the area and ensure that they meet established release criteria.[32] In addition, the Project Manager will perform contamination surveys on decontaminated areas once activities are completed to demonstrate compliance with pre-established release criteria.

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[32] Monitoring for total contamination will be performed using direct reading frisking equipment that under laboratory conditions can detect contamination at a minimum value greater than 200 dpm/100 cm^2 beta/gamma activity. Personnel with detectable contamination (>50 net cpm beta/gamma) on their skin or personal clothing will be promptly decontaminated.

7.4 Emergency Response

IEM is committed to minimizing unsafe conditions and eliminating emergency situations. The severity of an emergency can be reduced by implementing an appropriate and timely response. In order to minimize unsafe conditions, IEM and BMT will plan for possible emergencies prior to engaging in remediation activities at the MAB, will have available adequate supplies and manpower to respond, and will ensure all project personnel receive training in proper emergency response procedures.

The Site HSO is responsible for implementing and directing the emergency procedures in the event of an emergency. Specific duties are as follows:

- Identify the source and character of the incident, type and quantity of any release.
- Assess possible hazards to human health or the environment that may result directly from the problem or its control.
- Discontinue operations in the vicinity of the incident if necessary to ensure that fires, explosions, or spills do not recur or spread to other parts of the site.

8 RADIOACTIVE WASTE MANAGEMENT PROGRAM

At this time, the facility to be utilized for the final disposition of all excavated wastes is unknown. Final decisions on disposal locations will be made after the materials have been excavated and characterized. For planning purposes, however, the following arrangements will have been made in advance:

- Excavated wastes will be sent to a licensed facility for any necessary treatment, segregation or volume reduction.
- After treatment, the materials will be forwarded on to a licensed disposal facility.
- A full-service firm (to be selected) will serve as the waste processor and will be responsible for manifesting, transportation, brokering and arrangements for disposal of all of the waste materials.
- Excavated waste items that are deemed free of residual radioactivity above the release criteria shown in Section 10.1 will be sealed in plastic and taped shut prior to egress from the controlled work area.
- As described in Chapter 5, radioactive wastes will be promptly loaded into 55 gallon steel drums after any required radiation/contamination surveys are conducted and any samples are collected.
- Any wastes that may be considered "mixed wastes" (i.e., containing both radioactive and hazardous constituents, as may be associated with liquid scintillation cocktails) will be segregated and placed into separate drums.
- All drums will be appropriately marked as to its contents and estimated activity levels and a Container Inventory Form, as specified in a written IEM procedure, will be generated for each container.

IEM will solicit quotes from licensed mixed waste treatment subcontractors in the event that any mixed wastes are identified and characterized. A temporary storage area for the drummed waste will be designated at the site while waiting for disposal. All waste containers will be removed from the MAB as the final step in the project. Certificates of disposal and acceptance of custody records will be included in the final remediation report. All other waste handling operations will be performed pursuant to IEM's written procedure on the control of radioactive waste.

9 QUALITY ASSURANCE PROGRAM

Quality assurance/quality control programs are designed to ensure that all quality and regulatory requirements are satisfied. All activities affecting quality are controlled by the provisions of this chapter, which are outlined in the following sections.

9.1 Personnel

IEM project management and supervisory personnel are required to have extensive experience with IEM procedures and be familiar with the requirements of MARSSIM and this Plan. Management must have prior experience with the radioactive materials and a working knowledge of the instruments used to detect the radionuclides on site. Project management and supervision are required to maintain Occupational Safety and Health Administration (OSHA) safety qualifications as safety is a primary concern of IEM. IEM will select personnel to direct the survey based upon their experience and familiarity with the survey procedures and processes.

9.2 Training

All project personnel will receive site-specific training to identify the specific hazards present in the work and survey areas. Training will also include a briefing and review of IEM procedures and this remediation plan.

During site orientation and training, personnel will be familiarized with site-specific emergency procedures. In the event of an emergency, personnel will act in accordance with all applicable site emergency procedures and the provisions of this plan.

9.3 Written Procedures

All survey tasks, which are essential to survey data quality, will be controlled by procedures and this Plan. Changes to the procedures must be approved by the IEM Project Manager and reviewed by the personnel performing the remedial activities and final status surveys.

9.4 Selection of Instruments

IEM has selected instruments proven to reliably detect the radionuclides present at the site. IEM will have qualified vendors calibrate instruments under approved procedures using calibration sources traceable to the National Institute of Standards and Technology (NIST). In addition, all instruments and detectors will be inspected and source checked daily when in use to verify proper operation. Control charts and/or source check criteria will be established at the beginning of the project for reference. Procedures for calibration, maintenance, accountability, operation and quality control of radiation detection instruments implement the guidelines established in American National Standard Institute (ANSI) standard ANSI N323-1978 and ANSI N42.17A-1989.[33,34]

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[33] American National Standards Institute, *Radiation Protection Instrumentation and Calibration*, ANSI N323-1978,
(continued...)

9.5 Survey Documentation

Survey packages will be the primary method of controlling and tracking the hard-copy records. Records of surveys will be documented and maintained in the survey package for each area. Each survey measurement will be identified by the date, technician, instrument type and serial number, detector type and serial number, location code, type of measurement, mode of instrument operation, and Quality Control (QC) sample number, as applicable.

9.6 Chain of Custody

Procedures that establish responsibility for the custody of samples from the time of collection until results will be implemented. If samples are shipped off site for analysis, they will be accompanied by a chain-of-custody record to track each sample.

9.7 Records Management

Generation, handling and storage of survey data packages will be controlled.

[33] (...continued)
September, 1977.

[34] American National Standards Institute, *Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Normal Environmental Conditions*, ANSI N42.17A-1989, November, 1988.

10 FINAL STATUS SURVEYS

This chapter details the conduct of the survey and sampling effort, which will follow the guidance provided by the U.S. Nuclear Regulatory Commission (USNRC) and the Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM).[35] The following sections describe the release criteria, the survey and sampling methodology, and how the measurement results will be reported.

10.1 Release Criteria

The radioactive materials associated with the burial locations at the MAB include Co-60 at Site 6 and Ni-63, C-14 and H-3 at Site 6. However, no site-specific release criteria exist for the MAB. Therefore, alternative values that are reasonably conservative (i.e., designed to maximize the level of radiation protection) must be selected. For this plan, recent recommendations of the USNRC, described as follows, will be used as the basis for their selection.

The USNRC published the final rule on radiological criteria for license termination in 1997 where the USNRC required that facilities that previously used radioactive materials in licensed activities perform sufficient decontamination and radiation measurements to verify that exposures to the maximum exposed members of the public be less than 25 millirem per year.[36] Supplemental information was published by the USNRC in 1999 to provide screening values for surface soil that satisfy the license termination rule.[37] The USNRC completed a radiation dose assessment using the computer code, DandD. They used conservative assumptions for the physical and chemical features at the site to establish a surface soil concentration that would correspond to an annual dose of less than 25 millirem per year.[38]

Screening values were derived based on the selection of the 90th percentile of the output radiation dose distribution for each radioisotope present in surface soil (e.g. 15-30 centimeters from the surface). Each screening value was reported to correspond to the degree of soil contamination deemed in compliance with the unrestricted use dose limit specified in the USNRC regulations, that

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[35] U.S. Nuclear Regulatory Commission,"Multi-Agency Radiation Survey and Site Investigation Manual", NUREG-1575, Revision 1, August 2000.

[36] US Nuclear Regulatory Commission, *Radiological Criteria for License Termination*, Federal Register, Volume 62, page 39058, July 21, 1997.

[37] US Nuclear Regulatory Commission, *Supplemental Information on the Implementation of the Final Rule on the Radiological Criteria for License Termination*, Federal Register, Volume 64, page 68395, December 7, 1999.

[38] The assumptions were conservative such that the soil concentrations would likely result in a radiation exposure significantly less than 25 millirem per year.

is, less than 25 millirem per year.[39] They corresponded to the derived concentration guideline levels (DCGL) described in the MARSSIM guidance. The following are the screening values for the contaminants of concern at the MAB:[40]

- Co-60 - 3.8 picocuries per gram
- Ni-63 - 1,200 picocuries per gram
- H-3 - 110 picocuries per gram
- C-14 - 120 picocuries per gram

For the remediation of the MAB, these concentrations will be used as the release criteria.

10.2 Detection Limits

To ensure that walkover surveys of the remediated areas are sufficiently sensitive, the minimum detectible concentration (MDC) was calculated in accordance with Section 6.7.2.1 of MARSSIM (Scanning for Beta and Gamma Emitters - Scan MDCs for Land Areas).[41]

The minimum detectible count rate (MDCR) for a surveyor using a two-inch by two-inch sodium iodide detector was calculated. For a surveyor scanning at a speed of 1.0 foot/second with a background of 5,000 cpm, the MDCR was determined to be 690 counts per minute, assuming an index of sensitivity of 1.38 (consistent with a false positive proportion of 0.6 and a true positive proportion of 0.95) and a surveyor efficiency (p) of 0.5:

$$MDCR_{surveyor} = \frac{1.38 * \sqrt{5{,}000\ cpm * \frac{m}{60s} * 0.417\ s} * \frac{60s}{m}}{\sqrt{0.5}}$$

Converting the MDCR to an exposure rate using the detection sensitivity in Table 1, the surveyor is thus capable of achieving a scan MDC of 0.8 microR/hour above background.

However, it is important to note that this limit is only applicable to the three Co-60-bearing burial locations at Site 5. Final confirmation of the radiological status of the Site 6 location, if it is positively identified (see Chapter 5), must rely upon the results of soil sampling since the isotopes of interest do not emit sufficiently-penetrating gamma rays.

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[39] U.S. Nuclear Regulatory Commission, *Radiological Criteria for Unrestricted Use*, Title 10, Code of Federal Regulations, Part 20.1402.

[40] The screening values for Ni-63, H-3 and C-14 would only be applicable if the residual radioactivity is actually located (see Chapter 5, above).

[41] Ibid. NUREG 1575.

10.3 Survey Protocol

Instrumentation used to acquire measurement data will be appropriate for the type of radiation expected, of sufficient sensitivity and accuracy to detect the radioactive materials found at the site, and of sufficient quantity to support the activities. Each instrument will be labeled with a unique identifier (e.g., serial number of detector and rate meter) to enable traceability between instrument and survey records. The following is a listing of the types of instruments that may be used at the site:

- Two-inch by two-inch sodium iodide detector.
- Microrem meter.
- Thin-window (pancake) geiger-mueller (GM) detector.
- Plastic scintillator (alpha/beta phoswich detector).
- Gas-flow H-3 detector.

The final surveys of the ground surface will be conducted by measuring 100% of the remediated soil surface while holding the detector in close proximity to the ground (i.e., less than two centimeters from the soil surface).[42] When the surveyor detects elevated activity in a particular location, he will pause and obtain a count rate in that area. Any area exhibiting residual radioactivity that is distinguishable from background will be marked for further investigation. In addition, exposure rate measurements will be conducted at a height of one (1) meter above the ground surface at the location of maximum measured surface exposure rate.[43]

10.3 Data Conversion

Gamma exposure rates from the surveys survey will be converted to units of net exposure rate by the following methodology:

$$R_{net} = (R_{gross} - BKG_{ave}) \times CF$$

where R_{net} = the net measured exposure rate (cpm), R_{gross} = the gross measured exposure rate (µR/hr or cpm), BKG_{ave} = the mean background exposure rate applicable to the survey (µR/hr or cpm), and CF = an optional conversion factor to convert count rate instrument readings into units of "µR/hr" if instrument read-outs were in "counts per minute".

[42] Because the contour of the remediated areas is expected to be non-uniform, conventional walk-over surveys wherein the surveyor walks over the area in a serpentine fashion are not feasible.

[43] Because the surveyor may be performing measurements within an excavation, the background exposure rate is expected to be different from a background exposure rate measured while standing on the ground surface. Therefore, the surveyor will rely upon surface exposure rates to guide decision-making.

10.4 Sampling Protocol

The selection of the sampling locations will be designed to address the soil beneath each excavation, and the soil removed from each excavation at a depth that is nominally in proximity to the residual radioactivity. Because the residual radioactivity is expected to be located at least four (4) feet from the ground surface, the following is the sampling protocol that will be implemented:

- The excavation of each burial area will proceed unimpeded to a depth of no greater than three feet below the ground surface.
- One (1) 1,000-gram sample of soil will be collected from each subsequent foot of excavation until such time as the residual radioactivity is located and removed.
- The 1,000-gram samples from all but the final foot of excavation will be composted into a single sample, blended, and a 1,000-gram composite sample collected.
- The 1,000-gram sample from the final foot of excavation will be maintained as an individual sample.
- A single 1,000-gram will be collected from the soil immediately below the residual radioactivity once it has been removed.

A total of no less than three (3) soil samples will obtained in this manner from each of the burial locations.[44] These will be packaged, labeled, and forwarded to a commercial analytical laboratory for radiological analysis by an appropriate methodology (i.e., gamma spectroscopy for the Co-60 areas, liquid scintillation counting for the Ni-63, H-3 and C-14 areas). The radionuclide concentrations will be reported in units of "picocuries per gram of soil". The locations of the soil samples from the survey area and the background soil sample locations will be shown on maps and provided in the final report. As stated in Chapter 5, the excavated areas will not backfilled until all analytical results have been received and verified.

10.5 Documentation

All records pertinent to this survey effort shall be maintained pursuant to IEM's written procedure on records maintenance.[45] The final status survey report will contain, at a minimum:

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[44] Because field surveys for C-14 and H-3 will not be possible in the event that the Site 6 burial is positively identified, additional samples beyond the base set of three (3) may be collected/analyzed from excavation in order to ensure there is a sound technical basis for releasing this area for unrestricted use. The Project Manager will make the decision on the amount and distribution of additional sampling locations based upon his assessment of potential radiological conditions as the excavation progresses.

[45] In addition, copies of all IEM documentation, including work plans and survey reports, will be provided to BMT, prime USDA/APHIS environmental contractor for the MAB facility.

- A description of the purpose of the survey;
- A listing of the surveyor(s) and their qualifications;
- A description of the survey methodology;
- A complete and unambiguous record of the radiological status of the land area;
- Sufficient information and data to enable an independent re-creation and evaluation of survey activities and results at some future date;
- Copies of all Radiological Survey Forms, instrument check sheets, and calculation forms as required in IEM's written procedures on instrumentation and surveillance.
- The survey report should be self-contained, with minimal information incorporated by reference.

11 FIGURES

1 **Figure 11.1 - Most Likely Location of the "Unknown Radioactive Burial Site"**

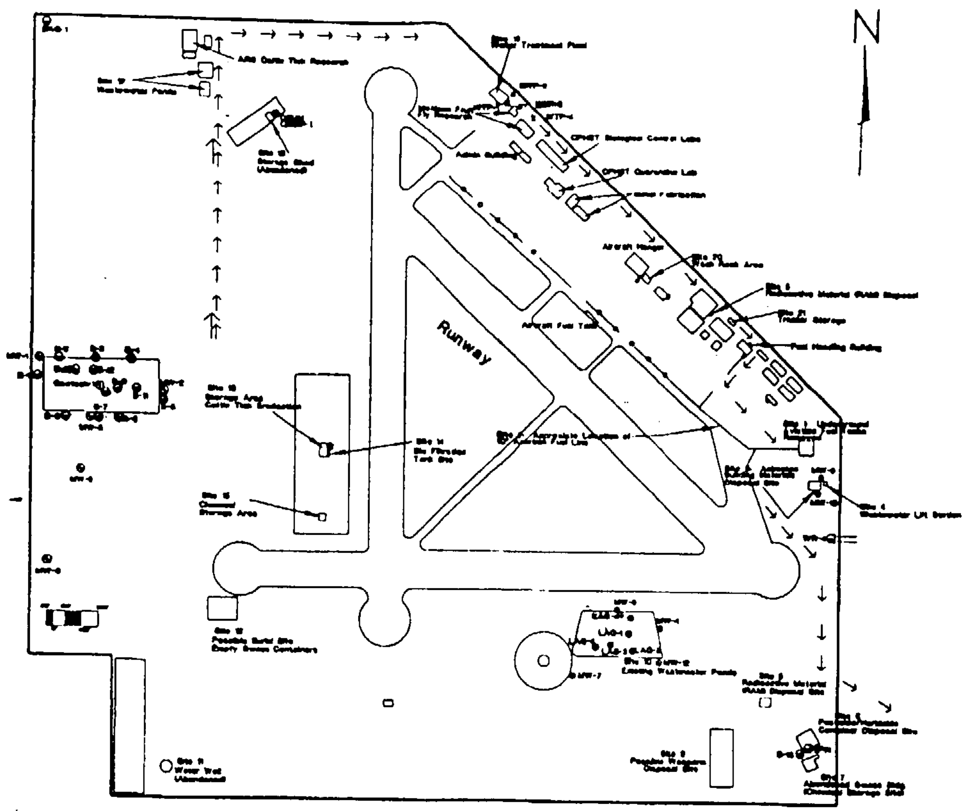


Figure 1.1

Moore Air Base
Facility Wide Map
Updated November 2003 By AR
File: T:\0304-03

Legend

- Geotechnical Soil Boring (2001)
- Soil Boring (2001)
- Monitoring Well
- Major Drainage Pathways

Note: In general, surface drainage at Moore Air Base is to the east. A series of drainage ditches convey overload flow offsite as indicated.

BMT Entech, Inc.
7918 Jones Branch Dr.
Suite 600
McLean, Virginia 22102

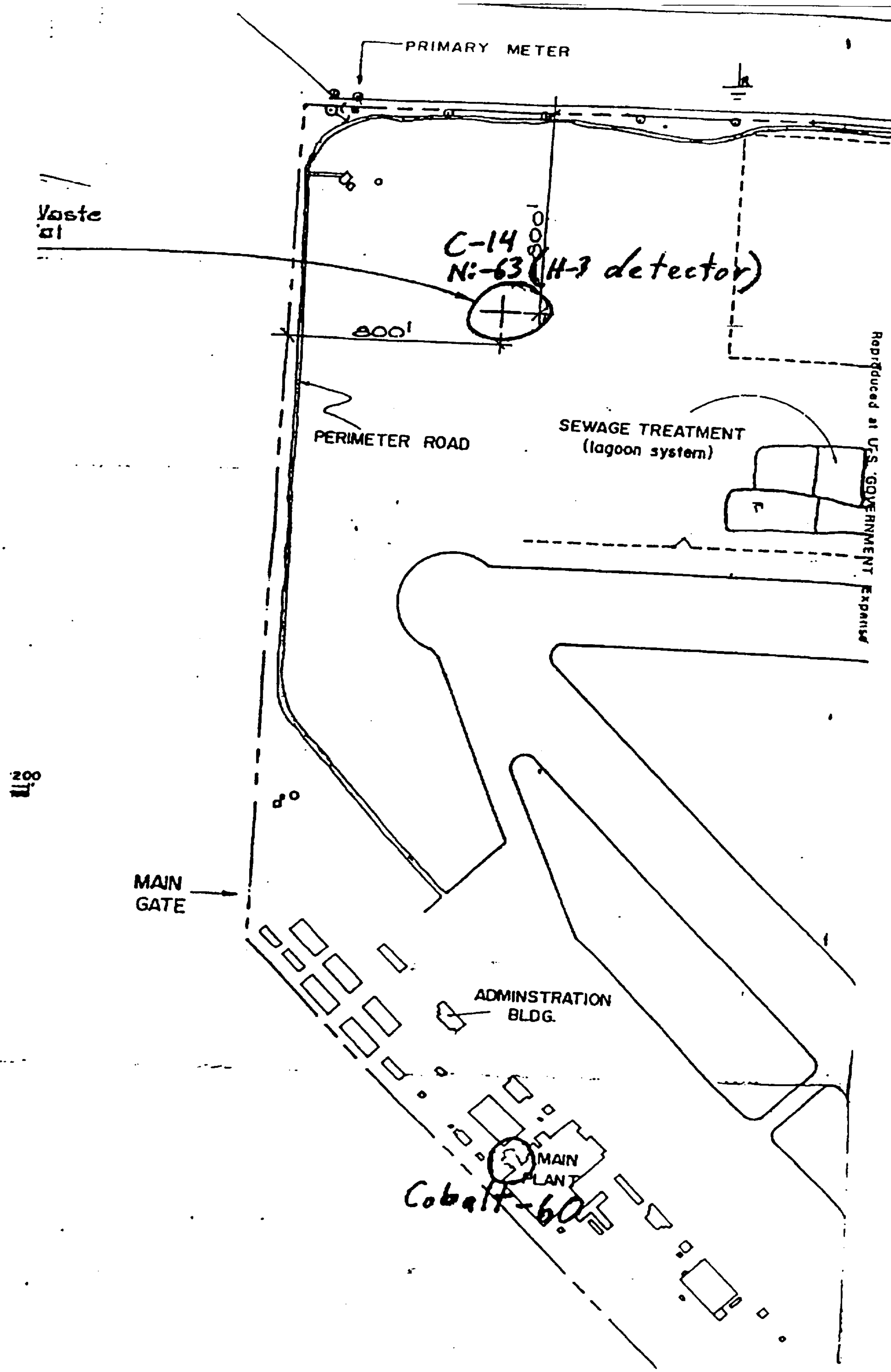
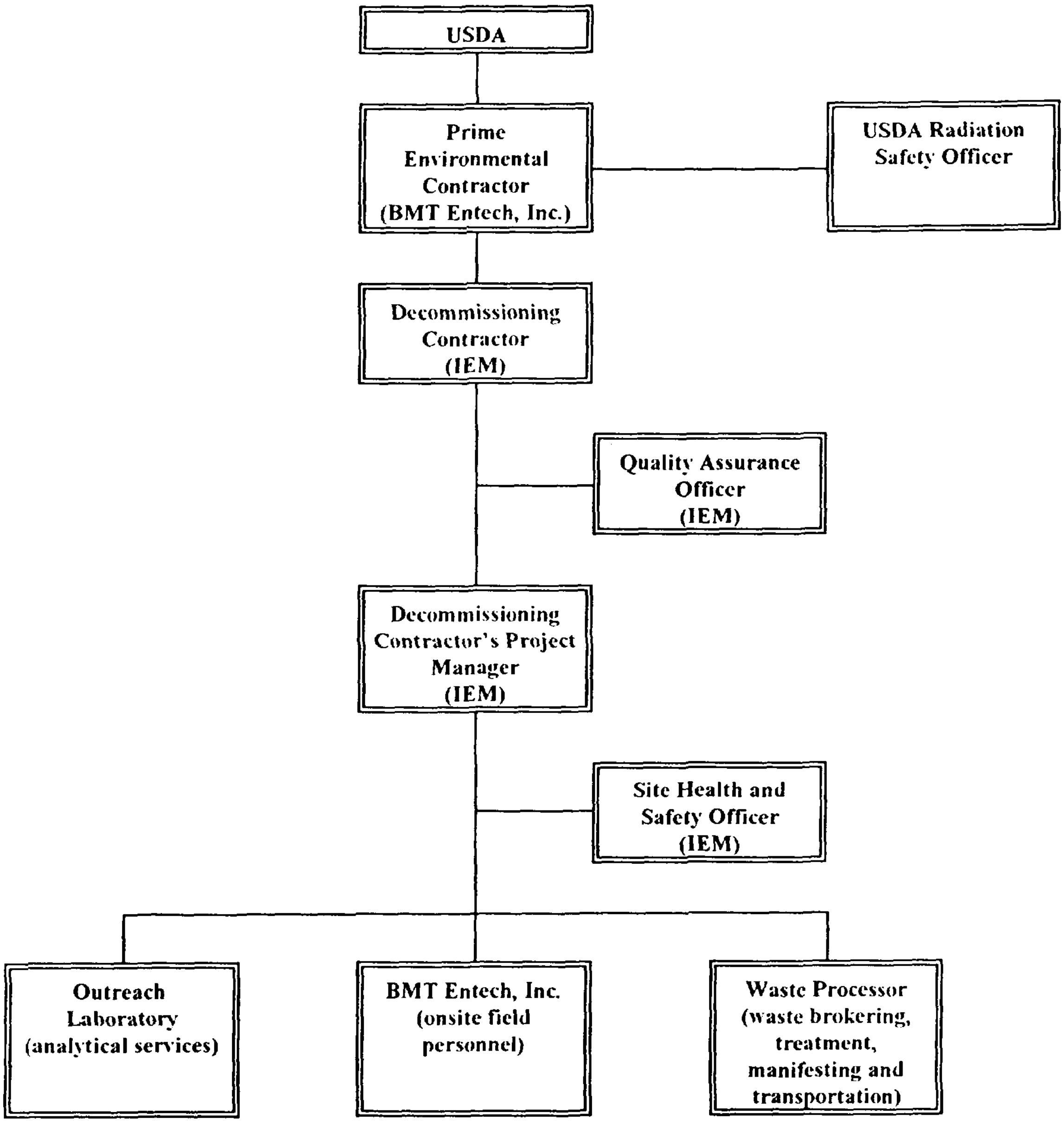

PRIMARY METER
C-14
Ni-63 (H-3 detector)
800'
800'
PERIMETER ROAD
SEWAGE TREATMENT
(lagoon system)
200
MAIN
GATE
ADMINSTRATION
BLDG.
MAIN
PLANT
Cobalt-60

Figure 11.2 - Project Organization Chart



12 APPENDICES

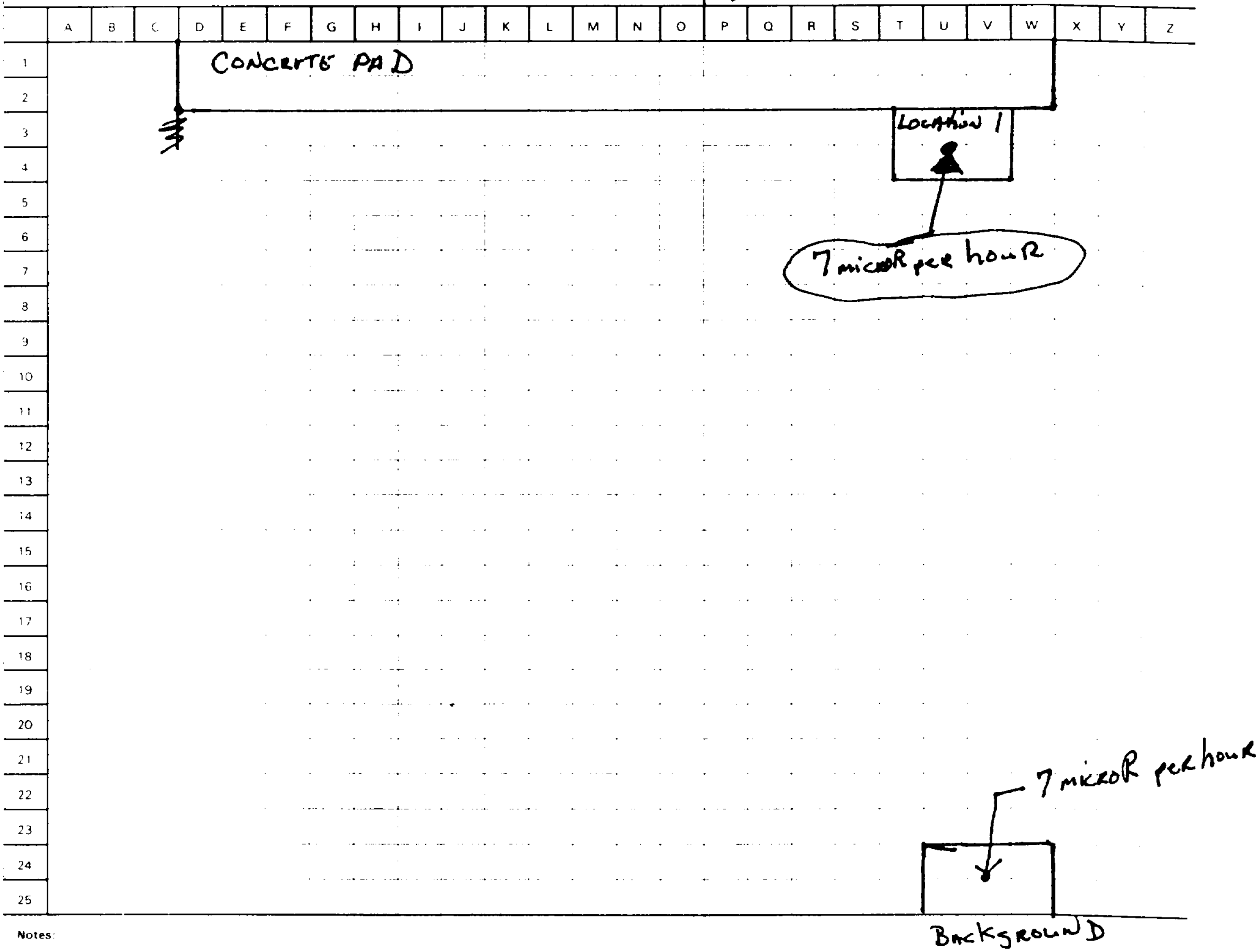
1 Appendix 12.1 - March 31, 2005 Survey Records

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number: Site 5, Location 1

Instrument SN: Model 19, 182678	Calibration Due: November 23, 2005	Site Name: Moore AIR BASE — Date: 3/31/05 — Time: 8:25 AM
Instrument SN	Calibration Due:	Location: Site 5, Cobalt burial site
Instrument SN	Calibration Due:	Purpose: Characterization survey
Survey Performed By (Print): Arthur W. Bonson		Survey Performed By (Signature): [signature]
✓ Battery OK — HV OK — ✓ Source Check OK		Grid Dimensions: 26' x 25' — meters / ✓ feet — inches / centimeters



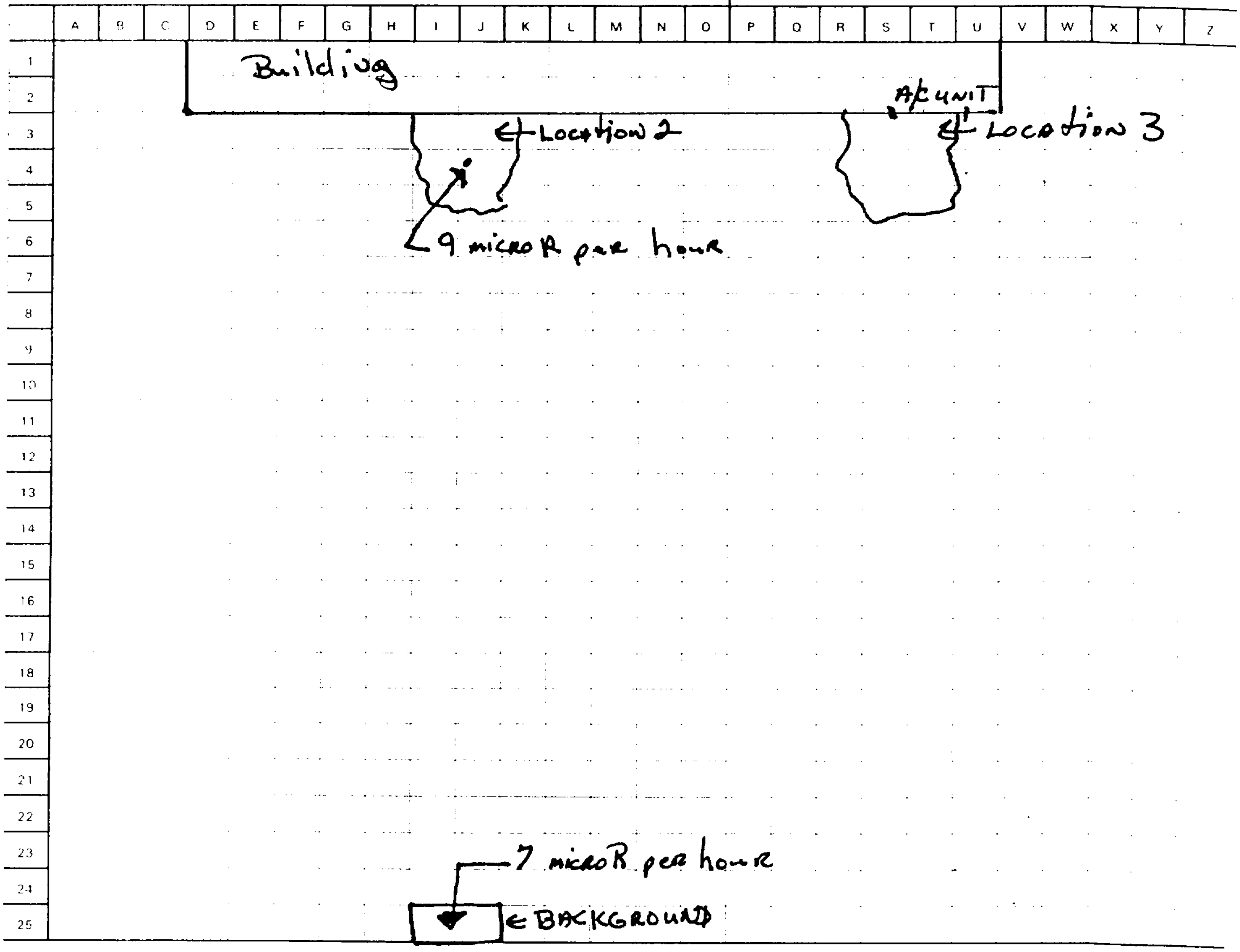
Notes:

RSP-018 (Rev. 001) Attachment 1

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.
RADIOLOGICAL SURVEY FORM

Survey Number: Site 5, Location 2 | Page 2 of 3

Instrument SN Model 19, 182678	Calibration Due: November 23, 2005	Site Name: MODEY AIR BASE Date: 3/31/05 Time: 8:35 AM
Instrument SN	Calibration Due:	Location: Site 5, Cobalt burial site
Instrument SN	Calibration Due:	Purpose: Characterization survey
Survey Performed By (Print): Arthur W. Benson		Survey Performed By (Signature): [signature]
✓ Battery OK	HV OK ✓ Source Check OK	Grid Dimensions: 26' x 25' meters ✓ feet inches centimeters



Notes:

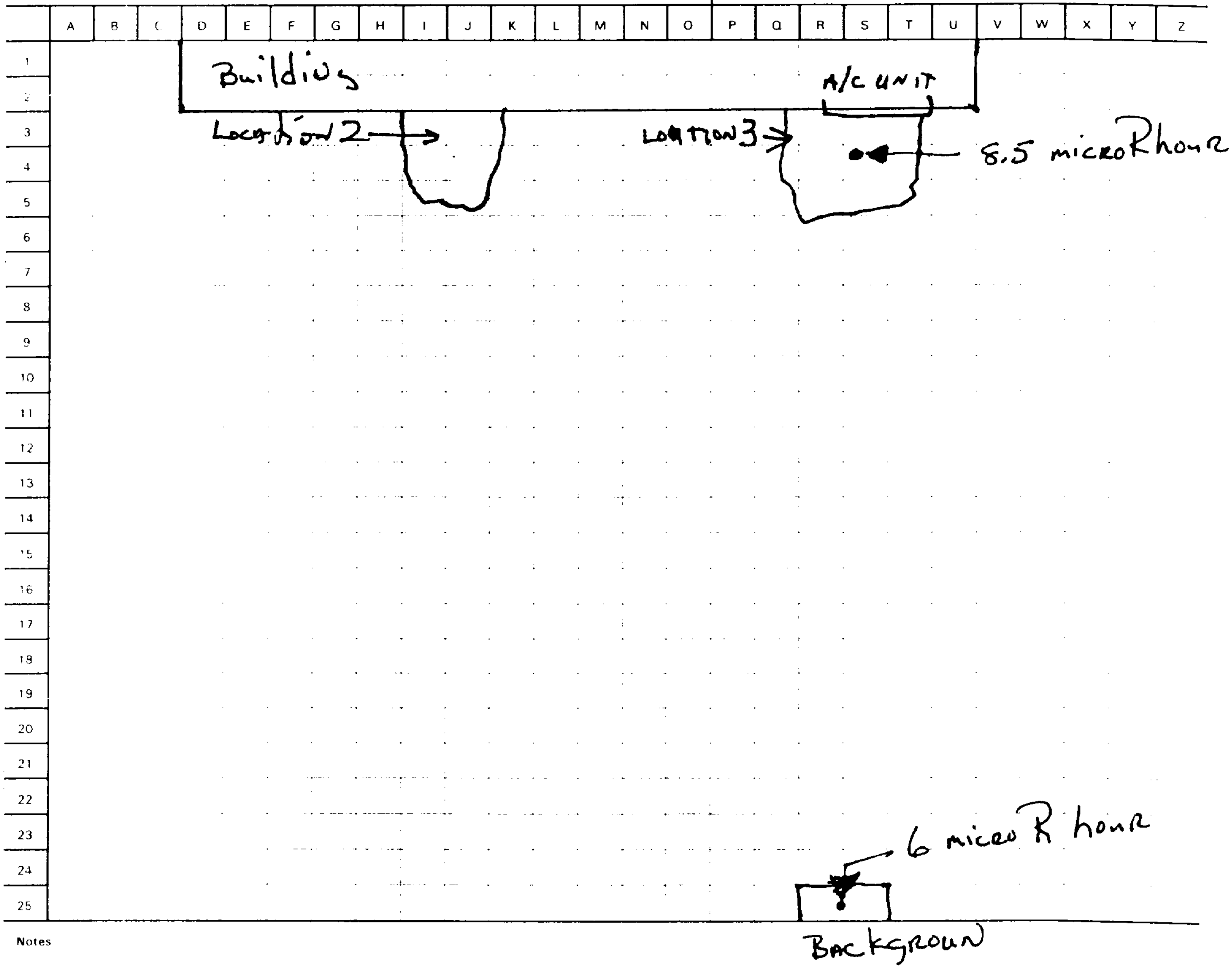
RSP-018 (Rev. 001) - Attachment 1

INTEGRATED ENVIRONMENTAL MANAGEMENT, INC.

RADIOLOGICAL SURVEY FORM

Survey Number: Site 5, Location 3 | Page 3 of 3

Instrument SN: Model 19, 182678	Calibration Due: November 23, 2005	Site Name: MOODY AIR BASE — Date: 3/31/05 — Time: 8:45 AM
Instrument SN:	Calibration Due:	Location: Site 5 COBALT BURIAL SITE
Instrument SN:	Calibration Due:	Purpose: Characterization survey
Survey Performed By (Print): Arthur W. BENSON		Survey Performed By (Signature): [signature]
✓ Battery OK — HV OK — ✓ Source Check OK		Grid Dimensions: 26' x 25'; meters / ✓ feet; inches / centimeters



Notes

RSP-018 (Rev 001) - Attachment 1

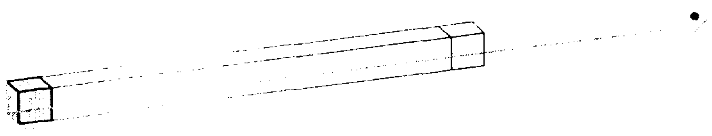
Appendix 12.2 - MicroShield Summary Reports

MicroShield v5.01 (5.01-00996)
Integrated Environmental Management, Inc.

Page : 1
DOS File: BMT-CAP.MS5
Run Date: April 5, 2005
Run Time: 4:34:33 PM
Duration: 00:00:02

File Ref: ________
Date: ________
By: ________
Checked: ________

Case Title: 2005006.01
Description: Dose rate 1 meter over cap from 1 microcurie Co-60
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.24 cm	6.0 in
Width	15.24 cm	6.0 in
Height	15.24 cm	6.0 in

Dose Points

	X	Y	Z
# 1	313.36 cm	7.62 cm	7.62 cm
	10 ft 3.4 in	3.0 in	3.0 in

Shields

Shield Name	Dimension	Material	Density
Source	.004 m³	Concrete	2.35
Shield 1	1.829 m	Concrete	1.68
Shield 2	.152 m	Concrete	2.35
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Co-60	1.0000e-006	3.7000e+004	2.8252e-004	1.0453e+001

Buildup
The material reference is : Shield 2

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+00	6.637e-18	9.964e-16	1.281e-20	1.924e-18
1.1732	3.700e+04	2.677e-11	1.330e-09	4.784e-14	2.377e-12
1.3325	3.700e+04	1.127e-10	4.392e-09	1.955e-13	7.620e-12
TOTALS:	7.401e+04	1.395e-10	5.723e-09	2.434e-13	9.998e-12

This is to acknowledge the receipt of your letter/application dated

5/5/2005, and to inform you that the initial processing which includes an administrative review has been performed.

Amendment 19-00915-03

[X] There were no administrative omissions. Your application was assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

[ ] Please provide to this office within 30 days of your receipt of this card

______________________________________.

A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 136963.
When calling to inquire about this action, please refer to this control number.
You may call us on (610) 337-5398, or 337-5260.

NRC FORM 532 (RI)
(6-96)

Sincerely,
Licensing Assistance Team Leader

BETWEEN:

License Fee Management Branch, ARM
and
Regional Licensing Sections

(FOR LFMS USE)
INFORMATION FROM LTS

Program Code: 03613
Status Code: 0
Fee Category: EX 3L
Exp. Date: 20050930
Fee Comments: ______
Decom Fin Assur Reqd: Y

LICENSE FEE TRANSMITTAL

A. REGION I

1. APPLICATION ATTACHED
   Applicant/Licensee: AGRICULTURE, DEPARTMENT OF
   Received Date: 20050506
   Docket No: 3004530
   Control No.: 136963
   License No.: 19-00915-03
   Action Type: Amendment

2. FEE ATTACHED
   Amount: /
   Check No.: /

3. COMMENTS

Signed Rebecca Junod
Date 5/9/2005

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered /__/)

1. Fee Category and Amount: ______

2. Correct Fee Paid. Application may be processed for:
   Amendment ______
   Renewal ______
   License ______

3. OTHER ______

Signed ______
Date ______